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A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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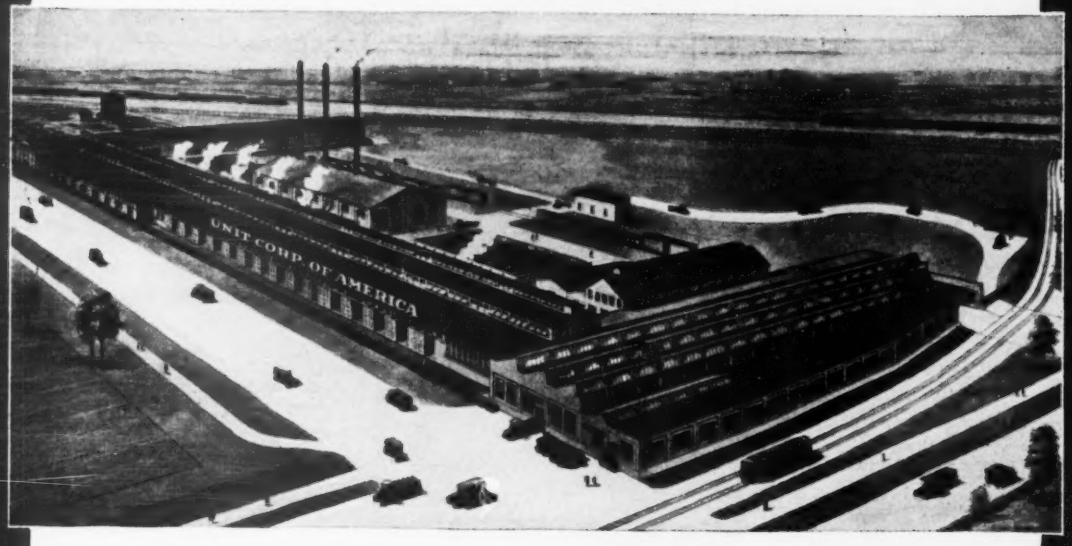

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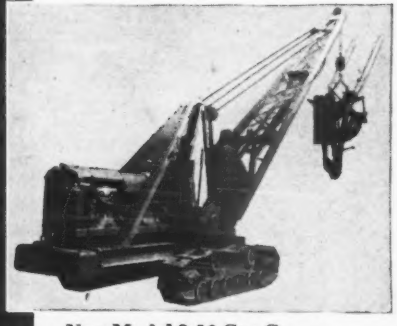

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, SEPTEMBER 19, 1929 Number 12

Bars Still Up

MAINE keeps up the bars against the export of power from within the state. Last week a bill amending the law which for years has prevented the export of power was defeated in a state-wide referendum vote. The bill was an attempt to gain for the state the advantages of large-scale power development without letting the surplus power of the present day pass beyond recall for future needs. It proposed, among other things, to put into effect what amounted to an export tax on power. Its constitutionality was not beyond question. Its defeat appears to have been due, however, to suspicion engendered by overenthusiasm on the part of its advocates—among whom were the power-generating companies—and to a fear that despite any safeguards which the state might set up power once exported from the state would pass beyond any adequate control, either state or federal.

For Better Lettering

IT WOULD seem unnecessary to caution engineers that the test of good lettering is its legibility; yet a glance at many current monographs, books and other technical publications reveals that this fact, although well known, is not sufficiently considered by engineers in the preparation of material for publication. The lettering on engineering drawings is essential, otherwise it has no place there. It follows that failure to make it clear is as serious a fault as failure to convey an idea properly and accurately in the text; indeed, a single drawing often carries more direct information than many pages of type. The remedy is simple—cut the amount of lettering to a minimum, make the characters a respectable size, allowing for the necessary reduction by the engraver, and do not crowd them. If these three simple rules be followed, the value of many engineering publications will be enhanced, and the readers saved many muttered imprecations.

Water-Borne Typhoid Again

WITH the increasing rarity of water-borne typhoid outbreaks each new occurrence becomes more outstanding. The reasons for increasing rarity—ready and inexpensive means of prevention—add to the culpability of any city authorities who fail to safeguard their community from needless danger, sickness and death. The latest and one of the most inexcusable instances of such negligence occurred recently at Ogden, Utah, as detailed elsewhere in this issue. True, the local authorities claim that water was not the cause of the outbreak, but both the state and federal health agents feel sure that it was and we believe epidemiologists generally would draw the same conclusions from the evidence presented. Moreover, the local authorities do not seem to have denied that a potentially dangerous situation had existed for some time and that they had been warned of its existence by representatives of the state Board of Health. The outbreak should be a warning to any and all communities which, placing their main dependence on a safe water supply, occasionally draw on a reserve supply that is liable to pollution, as was the case at Ogden. If conditions there were such that the emergency surface supply could not be given up, there appears to have been no reason why it should not have been chlorinated whenever drawn upon. Some cities seem to think they are warranted in claiming distinction because their water supply receives no treatment, a condition daily becoming more dangerous where supplies are from surface sources. Distinction of this kind proves to be unfortunate and costly when, as at Ogden, a typhoid outbreak comes, with death and damage lawsuits in its train.

A False Move

POLITICS makes strange bedfellows, and when the companion is engineering construction work, the latter is usually no better off for the association. San Francisco has just determined that none but its own citizens shall be employed on the Hetch Hetchy work. As fast as such men can be secured through a municipal employment agency, they are to replace aliens and non-residents now working on the project. This is undoubtedly good politics, but it is not good engineering. The Hetch Hetchy work is, at present, largely tunneling, work in which the qualities of skill and experience are of particular value. Good workmen for this kind of construction are not common, as is well known to those who have been on tunneling jobs, nor is it likely that many such are concentrated in the streets of San Francisco. It is probable that the ruling of the board of supervisors will be more honored in the breach than in the observance, but if it is enforced there is every reason to expect that each substitution accomplished will be at the expense of efficiency and the taxpayers' pocketbook. It is to be hoped that the supervisors will come to realize the danger of this pernicious ruling before it is too late.

Business as Usual

BUILDING replacement is constantly putting greater tasks on the constructor by demanding that a going service shall not be interrupted during the required working period. The Brooklyn (N. Y.) department store replacement described in this issue is an example. Here a large general merchandising service is being rehoused with scarcely a check in its efficiency by stage construction involving underbuilding foundation construction operations of notable ingenuity. Briefly, replacement is proceeding in fractions of the final building—a 40 per cent fraction first and then in sequence two 30 per cent fractions. With the new building greater in area and

taller than the old building, the existing merchandising space is never greatly decreased and after the first 40 per cent fraction of the building is completed, is increased with each fraction taken out of service. And finally with subterranean foundation construction as described in the article, the time that any fraction of the old building is taken out of service is several months less than if foundation work followed wrecking and excavation. In its plant and procedure the underbuilding foundation operations employ no means not well within the capacity of modern skilled operations in underpinning and subsurface excavation. Indeed, far more complex and hazardous tasks are being carried on daily in New York rapid-transit subway construction, and with a considerable measure of truth it might be claimed that adapted subway methods are making practicable the Brooklyn foundation operations. The importance of the methods, however, rests more on the fact that they are being used to evaluate time in terms of uninterrupted business service, which is becoming constantly a greater consideration in construction planning.

General Contracts Upheld

DECISION by the U. S. Treasury Department to do future building by general contracts, as announced three weeks ago, has been followed by a recommendation from the Department of Public Works of New York State that a similar reform be instituted in the enormous public building programs now under way and planned. Action is directed toward a somewhat different objective in the two instances, but in both it has the general purpose of getting away from uneconomic piecemeal appropriations and payments and from multiplication of agents and diffusion of responsibility. Buildings for public institutions and the administration of government are complex structures. A hospital, a normal school or a prison is not a building but a group of buildings having diverse functions and requiring certain general services as water supply, power, heat and sewerage. Each building engages in its construction a dozen or more trades which must operate in sequence and harmony. Management of construction so as to avoid delay under such conditions is a task of co-ordination of the highest order. Someone must perform this task; if it be not the general contractor, it must be the agents of the state or of the federal department. It costs money and it cannot be well done unless construction is a unified, continuous process which piecemeal provision of funds renders impossible. These are fundamentals of construction management, and they cannot be escaped by any device of separate contracts or continuing appropriations. Also there is the vital factor of responsibility for cost, as the Treasury Department has found out in several recent building operations and notably in the construction of the Government Printing Office, where union and non-union labor and jurisdictional conflicts which the department is without rights or funds to adjust have delayed work for months. The general contract, the department has found, has an economic value in guaranteeing costs. It calls for too much optimism to expect that great respect will be paid by either public or legislators to these calls for reform in public building financing and construction management, but at least it is comforting that straight business reasoning is on occasion being positively voiced by those who have the management of public building construction.

Counties and Regional Engineering

REGIONAL planning from outside in is so uncommon as to be noteworthy. It is all the more notable when, as in the case of Westchester County, New York, it is accompanied by the execution of comprehensive plans. True, this populous, wealthy and progressive county to the northward of New York City has had an eye to its own needs, and rightly so, rather than to those of New York and other parts of America's largest metropolitan district, but so much in common has each part of the district that no unit can serve itself efficiently without considering at least the most closely adjacent units. These reflections are prompted by the article on the extensive park, highway, sewerage and other work recently done and now going on in the county named.

To the men who are confronted with regional engineering needs in other parts of the country one of the most notable features of the Westchester County work is that it has been done by county agencies. Although the county government itself seems to have been too poorly equipped to take up the work or to be intrusted with it at the instance of citizens and taxpayers, yet its sanction to most if not all the expenditures has been necessary and appears to have been given ungrudgingly. This suggests on the one hand that the county is or may be more of an agent in regional engineering than has been regarded feasible heretofore and on the other the need for additional strengthening of county government both in Westchester County and throughout the United States. County engineering would be raised from a status far too low if only county government were lifted from its still lower plane.

Unique conditions north of the boundary between New York City and Westchester County have not only created regional problems within Westchester County but have also contributed to their successful solution. The population consists largely of one of the three overflows from New York City, the others being eastward to Long Island and westward to New Jersey. With the population have gone wealth, intelligence, energy and public spirit, all of which have made themselves felt in demanding improved conditions of community living and of travel within the county and to New York City. As a consequence, Westchester County is provided with parks, parkways and other major highways and trunk sewers that may well be a cause for envy elsewhere. Its water supply presents special problems not yet fully adjusted and its rapid transit facilities, like those of the entire New York-New Jersey Metropolitan District, have far to go before meeting the needs of a great public that works and lives at point many miles apart.

Without meaning to detract one bit from Westchester County achievements, it is only fair to other counties that receive New York's outflow to note that some of them began what may be termed county-regional developments long ago, lead in a county park system having been taken by Essex County, with other New Jersey counties following suit. Intermunicipal water-supply and sewage-disposal projects have also been carried out across the Hudson River. Park systems, though somewhat belated, are being provided eastward from Greater New York, on Long Island.

In none of the New York-New Jersey metropolitan districts, nor as a rule in any other part of the country has the county yet shown itself equal to meeting the regional demands that cry for attention. Some pass over

county boundaries, but many of them could be met, or far better met than now, if the county governments were more able, more honest and better deserved public confidence than they now do. Will the county grow stronger or weaker? In metropolitan districts will the county gradually give way to cities larger in area and population on the one hand, or, on the other, to intercounty metropolitan districts, created for one or more engineering services, such as major highways, water supply, sewers and parks? Whatever the outcome, an inborn desire to retain local self-government must be reckoned with, but how far is there justification for this in such engineering works as have been mentioned? In attempting to answer these and associated questions the methods and achievements in Westchester County merit consideration.

The President Acts on Mississippi Flood Control

PRESIDENT HOOVER has guardedly opened a way for reconsideration of portions of the diversion plans for Mississippi flood control. Upon expression by Senators and Representatives of the states concerned of their willingness to assume responsibility by making the request, he "will delay the undertaking of new work on that portion of the Mississippi flood control covering the so-called floodway from the Arkansas to the Gulf." As the announcement stands it is merely a public expression of intention. No executive order has been issued; this waits on formal request by the Arkansas and Louisiana members of Congress. Comment for the present is therefore necessarily tentative.

As the intention is expressed, consideration of plan revision is limited to the Boeuf-Atchafalaya basin diversion. The announcement not only names this overflow channel as the sole subject of consideration but as specifically by name excludes the Missouri and Bonnet Carré floodways and all levee strengthening. In brief, the Jadwin flood-control plan is to remain unaltered and even unquestioned except in the Boeuf-Atchafalaya basin, where the courts have already questioned its justice and temporarily halted action and where postponement may interfere with the full judicial examination of the issue which is needed to clarify the damage-and-benefit dispute that has raged all down the valley since the Jadwin plan was promulgated by a succession of executive orders by President Coolidge.

Concerning Bonnet Carré there has been no considerable difference of judgment and denial of review is not serious, but the Missouri floodway in many respects presents greater need for reconsideration than any of the others. In both engineering and economic aspects it involves hazards and offers problems far less determined than anywhere else on the river. Its exclusion from reconsideration has no justification beyond the fact that its setback levee has been rushed to contract and construction in the effort by the army engineers under General Jadwin to nail their arbitrary plan down too tight to be disturbed. There should be no limitation of inquiry to the Boeuf-Atchafalaya floodway—the deficiencies of the present diversion plans reach much farther.

In respect to the Boeuf-Atchafalaya diversion no program for review is indicated. This of course may be done when the executive order is issued; undoubtedly it should be done. Without a program an order of postponement would simply toss the entire Boeuf-Atchafalaya question into the air to be buffeted about by the currents of diverse opinion, leaving Congress again as in 1928 grasping for something tangible to which to fasten revision or amendment of the present plan. Engineers will expect, with the executive order delaying work, definite advice for review on which Congress can act. And Congress in being asked to reconsider its legislation is entitled to this direction. Neither it nor the public is likely to be patient with any unconsidered and undirected program for changing a plan arrived at with difficulty only two years ago and having powerful advocates with a defensive campaign well worked out.

While many questions thus await precise answer before President Hoover's announcement on flood-control revision can be indorsed as wholly satisfactory even in its partial step to retrieve a bad situation, it opens the door (at least on chain) for engineering thinking not fixed by bureaucratic policies. Whether the opportunity is put to real purpose will depend upon the engineering profession itself. If engineering is to justify its right to leadership in thought on the greatest problem of river hydraulics that has ever come before it, there must be definite and purposeful action. There will be definite and purposeful action by the advocates of the present plan to maintain its essential integrity.

Research and Confidence

STRUCTURAL engineers and welding specialists alike have ample cause to regard the meeting of the American Welding Society in Cleveland last week with considerable optimism. For out of it came substantial promise that means are at hand or almost at hand whereby a weld may be definitely evaluated without destroying it. And also out of the meeting came F. T. Llewellyn's pronouncement in his presidential address that the one aim of the present administration is to create confidence in welding. It is no secret that the structural engineer has lacked confidence in welding in spite of many successfully welded structures that raise themselves to shake his belief. Furthermore, it is true that the bulk of his uneasiness concerning the safety of welding has arisen from his lack of non-destructive testing means. Visual inspection is too intangible to be entirely adequate. Much hope, therefore, rests in the announcement of successful research on three tangible testing and inspection methods of a non-destructive nature: The physician's stethoscope was found an effective means of detecting flaws in welds; the X-ray disclosed the location of flaws on its shadowgraphic negatives; and the electric current, found to balk at a flaw, was made to reveal the balk on the chart of recording apparatus.

Time and again experience has shown that real progress in any technical field is dependent upon these two factors—research and confidence. They have provided a rich legacy for the concrete art; one has followed the other in the field of alloy steels for bridges; and aviation is now reaping its reward in confidence for many years of diligent research. There is no question that welding research has hardly begun in the field of structural steel. In view of the American Welding Society's expressed desire to create confidence, this research is certain to be carried on with increasing zeal. If history repeats itself, this research will provide the structural engineer with the confidence in welding that he has longed for. Therefore his cause for optimism at the present outlook.

Bronx River Parkway on Site of Former Swamp

Translating Theory Into Practice in Regional Engineering

History, Status and Progress in Westchester County, N. Y., With Special Reference to Railroads, Parkways and Other Arterial Highways, Park and Recreational Areas, Trunk Sewers and Water Supply

By Jay Downer and James Owen

Chief Engineer and Senior Assistant Engineer, Westchester County Park Commission

Based on the Experience and progress of Westchester County in handling its regional engineering problems, the emphasis in this article rests on the importance of bridging the gap between theoretical planning and its translation into practical execution and accomplishment. The three means of effectually bringing plans to fruition in Westchester County are as follows: (1) It has demonstrated its ability to maintain an efficient, active local county control rather than to submit to annexation to New York City. (2) Prosecution to completion of one feature, the Bronx River Parkway, has given visual evidence of the fuller plan and with it the support of the people. (3) Political honesty for 30 years has built up an unusual amount of confidence which backs any projects submitted. In fact, a superconfidence is engendered which often calls for new projects ahead of the time the officials consider them wise or timely.

Westchester County, lying to the northward of New York City, with visible demarcation from the metropolis, has led the way in regional engineering accomplishment and official planning for the future. It has done this despite a rather weak framework of county government, through special commissions with the support of the county supervisors and particularly of the citizenship. Annexation to New York City, with loss of local government by cities, villages and towns, has thus been made unnecessary. The following story of these notable accomplishments continues earlier articles on Regional Engineering in *Engineering News-Record*: (1) Introductory, Oct. 4, 1928, p. 496; (2) Chicago Region, Nov. 22, 1928, p. 758; (3) Milwaukee Region, April 11, 1929, p. 585; (4) New York Region, June 6, 1929, p. 907.—Editor.

THE experience of Westchester County, N. Y., in handling her regional engineering problems leads to certain observations which seem to be of deeper fundamental significance in their bearing on practical accomplishment than any description or discussion of the problems themselves. Among these, attention first may be directed to this county's demonstrated independent ability to handle major regional problems co-ordinated in plan with the adjacent metropolis without annexation to the metropolis. Indeed, Westchester County is boldly attacking its own problems and pressing inward on the metropolis some of the most urgently needed regional improvements, such as railroad transit and motor traffic parkways, thus reversing the commonly assumed direction of initiative in regional planning and accomplishment proceeding from the center outward.

A second broad generalization in regard to Westchester's experience suggests the importance of putting through to completion some one feature or project in such a way as to win public support for further undertakings—for example, the demonstration afforded by the Bronx River Parkway development enlisted public

sentiment for the greatly expanded county park program which followed.

The final generalization relates to the hiatus between planning and execution. An obvious factor is that recognition of the broad problems of metropolitan growth, the theoretical planning of regional areas, and engineering technique have outrun the progress made by government in applying readily available means to the solution of such problems. Westchester is extremely fortunate in the quality of its citizenship and the fact that its county government, although obsolete in form, rests on a foundation of honest administration for an unbroken period of more than 30 years. On this record the citizens are willing to back their officials in public improvement programs. As to the park and parkway program, public sentiment

SWAMP ALONG BRONX RIVER PRIOR TO BUILDING PARKWAY NEAR NORTHERN BOUNDARY OF NEW YORK CITY

and the demand for expansion are considerably in advance of what the officials consider to be a safe and conservative procedure. The conclusion indicated is that political honesty is of greater importance than the form of government.

Location and Early Development

Lying between the Hudson River and Long Island Sound, Westchester County embraces a roughly funnel-shape area of 448 square miles of territory, forming the only mainland approach to New York City. By geographical relationship and innumerable strands of economic and social ties, this county's destiny is inseparably interwoven with that of the great metropolis. Westchester is, however, one of the twelve original counties of the State of New York erected in 1683 by the provincial legislature of what was then the Province of New York. As a political entity it always has been and is to the present day entirely independent of New York City. The people of the county have a strongly developed civic consciousness and a preponderant sentiment in favor of remaining independent.

Occupying about 1½ times as much territory as the whole of Greater New York, the county itself is an extensive regional area with respect to its 45 subordinate municipalities, made up of four cities, 23 villages and eighteen townships. Its rapidly increasing growth and population give rise to one class of engineering problems regional in character but wholly confined within its own borders. Under this classification are local water supplies and trunk sewers whose drainage areas lie wholly within the county. Another class of facilities, such as parkways, highways and railroad lines, involves continuity with like facilities and the planning of the adjoining areas of the metropolitan district. In this respect the county as a whole must be regarded in its physical aspects as a unit of a superregion.

Subject to modifications due to the local geographical and physical characteristics of its territory, the regional engineering problems of this county arise from the same causes and have fundamental similarities in common with those of many other areas which are rapidly being overspread with the outward pressure of growth from large cities. This growth is epitomized very largely in terms of advances in transportation and communication.

In recent years the growth northward from the arbitrary line which is now New York City's northern boundary may be more properly described as a surge into Westchester's territory as far north as an imaginary line drawn easterly from Tarrytown, on the Hudson River, through White Plains and extending down to Port Chester on Long Island Sound.

Westchester County's growth has been very largely residential in character, resulting from the quest for better and more healthful living conditions than the city affords. It seems reasonably certain that the county's future destiny is to be limited very largely to residential uses, to which it is well adapted both by reason of scenic attractiveness and accessibility. A very small

PARKWAY GRADE SEPARATION

proportion of the county's area is devoted to industrial purposes. Public sentiment favors residential growth and is backed by the zoning ordinances which have been adopted by practically all of the local municipalities. Of deeper fundamental and economic significance than zoning ordinances, however, is the likelihood that industry on a large scale will continue to gravitate to areas such as the flat, vacant expanses of the Jersey meadows threaded with water and rail transportation facilities, in preference to the rugged ridge and valley topography of Westchester County. The planning and development of Westchester County are, therefore, being shaped toward maintaining and enhancing its natural endowment as the most attractive and conveniently situated residential area in the New York metropolitan district. To this end there must be provided the conveniences and as many as possible of the refinements of modern

civilization for a present population close to 500,000 people, with due regard for the rapid rate of increase and probable requirements in the not distant future. The necessities of this main purpose give rise to Westchester County's regional problems.

Regional Engineering Problems

The principal regional engineering problems are those involved in adequately providing the following services: (1) railroad facilities to meet the requirements of the rapidly increasing volume of daily commuter traffic to and from New York City; (2) motor traffic arterial routes, both parkways exclusively for all passenger or pleasure traffic and highways for commercial or business traffic; (3) park and recreational areas; (4) water supply; (5) trunk sewers. No pretense is made at listing the complete requirements for the orderly development and full ultimate growth of Westchester County. The purport of this list is to throw into relief the major necessities which constitute a sizable burden, without going, for the purposes of this article, farther afield to theorize about the county's full ultimate development.

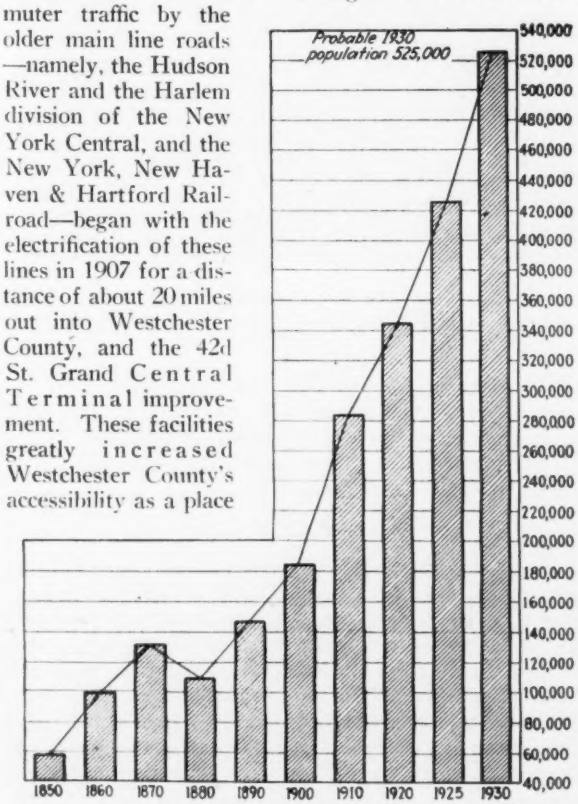
The first of these items is vitally important but is beyond the territorial and exclusive jurisdictional control of Westchester County, because the need is for increased trackage, distribution and terminal outlets for Westchester commuters, but all within the limits of New York City. The Westchester County authorities are fully prepared with a carefully studied plan but in action are limited to pressing the state authorities for legislative action creating or designating an agency empowered to make the plan effective.

Three of the four remaining items—parks, highways and trunk sewers—fall within the province of the county alone to meet, but the water-supply problem is interrelated to that of New York City. These items will be discussed in due course, but from a regional planning standpoint the park system at the present stage of the county's development must be assigned the degree of precedence to which it is entitled on the basic principle that in the building of a city or a region, parks should be established in advance of other improvements. The park system has, furthermore, created property values and revenues which have made it immediately self-sustaining. It is more than a park system, because it embodies the fundamental features of a broad general development plan for the entire county.

Expansion of the railroad facilities for suburban passenger traffic into New York City is the most vital problem now facing Westchester County. The attractiveness and adaptability of this area and the strong trend toward residential uses have been mentioned. But the development of its possibilities is contingent upon convenient transportation accommodations. Westchester County's contribution of commuter traffic must be considered in its relationship to the general traffic problem of New York City and its whole metropolitan district. But the city has its hands somewhat more than full with the problem of providing facilities for traffic orginating within its own boundaries and will never be able nor should it attempt to assume the added burdens of constantly increasing suburban traffic. On the other hand, it is not wholly clear that the various railroads entering the city would be able to handle the situation alone, and competent authorities believe that no workable solution can be based on merging or superposing Westchester's traffic upon the overloaded existing city subways and transit lines. The fundamental requirement is to provide new and additional facilities within New York City and to see that these are effectively co-ordinated with Westchester suburban lines.

The bulk of the Westchester service is provided by the New York Central Lines and the New York, New Haven & Hartford Railroad. These roads, leading out of New York City through Westchester County, were among the earliest railroads built in the United States. The Hudson River division, following the easterly shore of the river through Westchester County, and the Harlem division, following the Bronx River valley up the center of the county, were in operation by 1850. The New York, New Haven & Hartford Railroad, swinging easterly to follow the Long Island Sound shore, was put into service in 1848. Following the Saw Mill River valley on the westerly side of the county, the Putnam Railroad was built in 1880 and later was acquired as a division of the New York Central. The last railroad built through Westchester territory is the New York, Westchester & Boston, which started to operate in 1912 to New Rochelle and White Plains and was recently extended to Port Chester.

The modern era in the handling of Westchester commuter traffic by the older main line roads—namely, the Hudson River and the Harlem division of the New York Central, and the New York, New Haven & Hartford Railroad—began with the electrification of these lines in 1907 for a distance of about 20 miles out into Westchester County, and the 42d St. Grand Central Terminal improvement. These facilities greatly increased Westchester County's accessibility as a place



POPULATION INCREASE IN WESTCHESTER COUNTY, 1850-1925

Year	Population of Westchester County	Per Cent of Increase	Population of N. Y. State	Per Cent of Increase
1850	58,263	....	3,097,394	27.5
1860	99,497	70.6	3,880,735	25.3
1870	131,348	32.0	4,382,759	12.9
1880	108,988	*	5,082,871	16.0
1890	146,772	34.6	6,003,174	18.1
1900	184,257	25.5†	7,268,894	21.1
1910	283,055	34.8	9,113,614	25.4
1920	344,436	21.7	10,385,227	14.0
1925	425,798	23.6	11,162,151	7.4

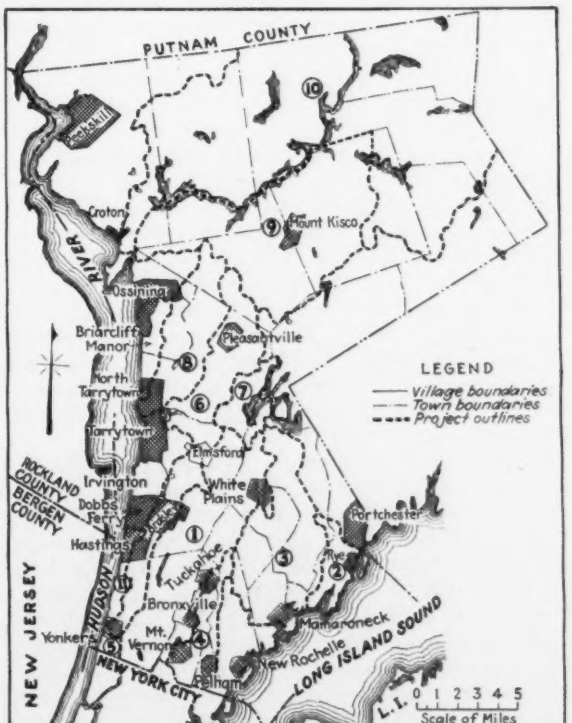
*Decrease due to annexation by New York City of 12,317 acres of Westchester territory in 1874.

†Reduced rate of increase due to annexation by New York City of 14,500 acres of Westchester territory in 1895.

of residence, but are now overtaxed by the heavy growth of traffic. The Putnam and the New York, Westchester & Boston lines do not enter the terminal, but stop at points north of the Harlem River, necessitating a break in the journey of commuter traffic to transfer to city elevated and subway lines.

Exhaustive studies of New York City's suburban transit problem have been made during the past seven years by various authorities. Between 1920 and 1926 eight different reports and plans for improving New York suburban passenger service were formulated by various engineers, official and other agencies, including the Transit Commission of the State of New York, Committee on the Regional Plan of New York and Its Environs, North Jersey Transit Commission, New York, Westchester & Boston Railroad and New York State Suburban Passenger Transit Commission.

The latest contribution to the subject is that of the Westchester County Transit Commission, appointed by the Board of Supervisors in June, 1921, under authority of an act of the New York State Legislature. A preliminary report was submitted by this commission in 1923 and a final report, presenting both a physical plan of construction and method of financing out of earnings without assessment or taxation, was submitted in 1926. The proposed plan is to bring together the three divisions of the New York Central, the New York, New Haven & Hartford and the New York, Westchester & Boston at 149th St. From this point a new four-track subway carrying through trains without transfer would pass under the Harlem River and down Madison Ave., University Place and West Broadway to the southerly end of Manhattan Island, but at a lower level than existing subways.



TRUNK SEWER DISTRICTS OF WESTCHESTER COUNTY

In its broad outlines this plan offered by the county authorities squarely meets the problem of financing on the basis of making the system self-supporting out of its own earnings. But its practical realization and coordination through transfer and contact points with existing or other proposed facilities involve the designation or creation of an agency by the state authorities and the negotiation of working agreements among the county, city and railroad authorities.

With a view to carrying the proposed or some satisfactory alternative plan into effect, Westchester County representatives in the state legislature introduced a bill authorizing the Port of New York Authority to proceed with the work of providing adequate facilities. This bill was passed by the legislature but was vetoed by the Governor at the close of the session of 1928. A similar measure presented by the Westchester County authorities at the 1929 session of the legislature, asking that the Port Authority or any other commission or body of competent jurisdiction be empowered and directed to proceed with the work, also failed to pass.

Westchester County Park System

If the map of Westchester be stripped of all other detail, the park system, and particularly the arterial traffic parkways, appears as embracing the main elements of a general plan which will very largely mold the future development of the county. This system should be visualized as having been superimposed upon a stratum of existing suburban development which was rapidly closing up all vacant spaces in the southerly part of the county. Naturally the plan could not be wholly idealistic because compromises had to be effected with existing conditions. The lines of this regional park system were dictated by certain well-defined fundamentals combining not only planning but economic principles involving the following considerations:

Elemental Features—Waterfront parks along the Hudson River and Long Island Sound shores, and interior parks, reservations and forest preserves providing for a wide range of recreational uses. An interconnecting system of traffic parkways.

Economic Utilization of Land—Selection of the cheapest undeveloped lands such as marshes, stream and pond margins, or rocky uplands undesirable and difficult to develop for residential or business uses but ideal for park purposes and as such allocated to their most valuable economic utilization in the general scheme of county development.

Adaptation to Physical Characteristics of Region—The diversified irregular and somewhat bold topography precluded conventional geometric planning. Such planning could not be rationally or economically adjusted to the physical conditions.

Adjustment to Existing City, Town and Village Developments—Interwoven with the foregoing was the necessity for effecting the most feasible compromise with existing conditions of the, in a regional sense, unplanned suburban growth already established.

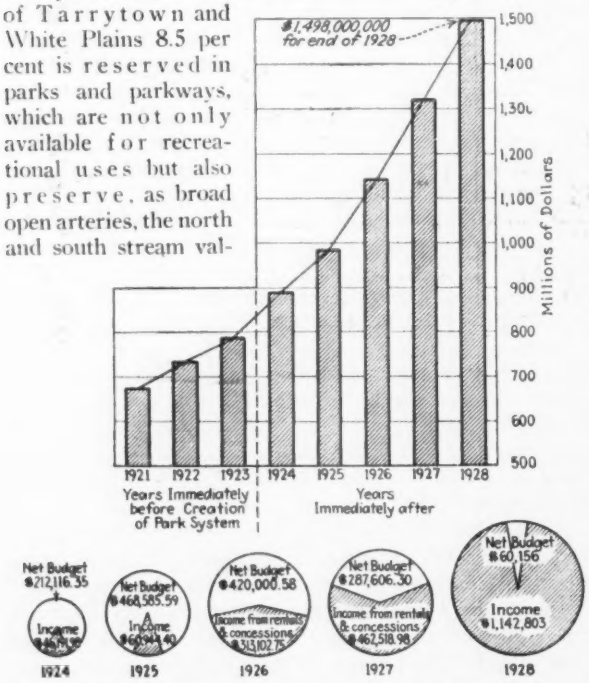
Rapidity of Execution—One of the most important elements was prompt action in acquiring lands in advance of rapidly rising values, leaving the shortest pos-

sible gap between planning and the execution of this phase of the program.

The guiding principles in shaping Westchester County's major regional development program have been outlined. The concrete results of five years' work from 1923 to 1928 are as follows: Nearly 16,000 acres of land has been acquired, including 9 miles of beaches and shore lines. Seven new large-scale recreational developments, including beaches, bathhouses, swimming pools, athletic fields, three golf courses and a seaside amusement park have been put into public service with as many more large natural park areas available. The lands acquired include 140 miles of routes for traffic parkways, in carefully studied co-ordination with the existing highway system. Thirty-three miles of fully developed parkways, including 40-ft. paved driveway, have been completed and opened to traffic.

The foregoing statements represent the credit side of the account from the standpoint of human welfare and planning for the future. The apparent financial debit is appropriations aggregating $32,352,000 for land and $22,492,900 for construction, a total of $54,804,900. But actually and as demonstrated by the accompanying economic chart is no financial debit.

The creation of enhanced property values due to the park system is producing tax revenue fully carrying the capital investment of $50,812,900, and the operation and maintainance expenses are being met by direct income from rentals, concessions, bathhouses, golf courses and amusement park facilities. Including the Bronx River Parkway, which had been established as a single project prior to the general program, this Westchester County park system of 16,939 acres embraces 6 per cent of the county's total area. In the area of densest growth south of Tarrytown and White Plains 8.5 per cent is reserved in parks and parkways, which are not only available for recreational uses but also preserve, as broad open arteries, the north and south stream valleys lying in the direction of traffic flow to and from New York City. These valleys, moreover, not only afford trafficways following the lines of least resistance but are also the natural routes for trunk sewers and may possibly be utilized for future water-supply conduits and other public utilities.



HOW PARK SYSTEM HAS CREATED WEALTH IN WESTCHESTER COUNTY AND MET INCREASING PART OF ANNUAL BUDGET

In the lower graphs the full circles represent operating and maintenance budgets; shaded areas, rapidly increasing revenue from rentals and concessions and unshaded areas the diminishing net contributions to balance annual budgets. Greatly increased park facilities were operated in 1928 at a much lower net cost to the county than was the case in earlier years.

The full ultimate development of Westchester County has not yet been planned, but the park system provides some of the most important features clearly indicated by the physical characteristics of the region as essential main elements of any regional development plan.

The park system is under the administrative authority of the Westchester County Park Commission of six members serving without compensation and appointed by the county Board of Supervisors under authority of an act of the state legislature.

Highway System: Bypasses and Cross-Routes Needed

Westchester County's principal highway problem is the reconstruction of old-established roads, many of them dating back to the colonial period. The crux of the problem is presented by the closely built up, congested sections of cities and villages strung at intervals along the main roads.

The outlying stretches of such roads can be improved readily to meet the requirements of modern arterial highway, but abrupt angles of alignment, steep grades and constricted widths flanked by buildings form a formidable combination through local community and business sections. Modernized reconstruction to rectify these conditions involves excessive right-of-way costs and, even if accomplished, results only in a broadened highway with frequent grade crossings at intersecting streets The conflict and competition of long-distance through traffic with purely local traffic would still remain after widening. The only effective as well as economically feasible remedy is to provide bypass routes. The comprehensive system of parkways already described embodies this principle. The segregation of passenger and pleasure traffic on the new traffic parkways which are laid out to bypass local business centers and with grade separations at all important intersecting highways will afford a large measure of relief for the older system of highways overloaded with a large volume of through traffic between New York City and the upper part of New York State and New England in addition to localized traffic movement.

A considerable proportion of Westchester County's road network was evolved from Indian trails or from primitive roads of the early settlers leading from farms to grist and saw mills along the interior streams or to water transportation points along the Hudson River and Long Island Sound. The main framework of through roads embraces the Albany Post Road, following the Hudson River shore; the Boston Post Road, along the Long Island Sound shore, and the Post Road, through the middle of the county to White Plains and extending northward. All three of these roads come out of New York City and traverse the full length of the county in a general north and south direction. In so far as concerns their continuity through the county in its longest direction, these three routes may be rated as arterial, but their effectiveness and traffic capacities are subject to the limitations imposed by the constricted sections through local business centers.

There is a serious lack of east and west routes across the county from the Hudson River to Long Island Sound due to the barriers presented by a series of north and

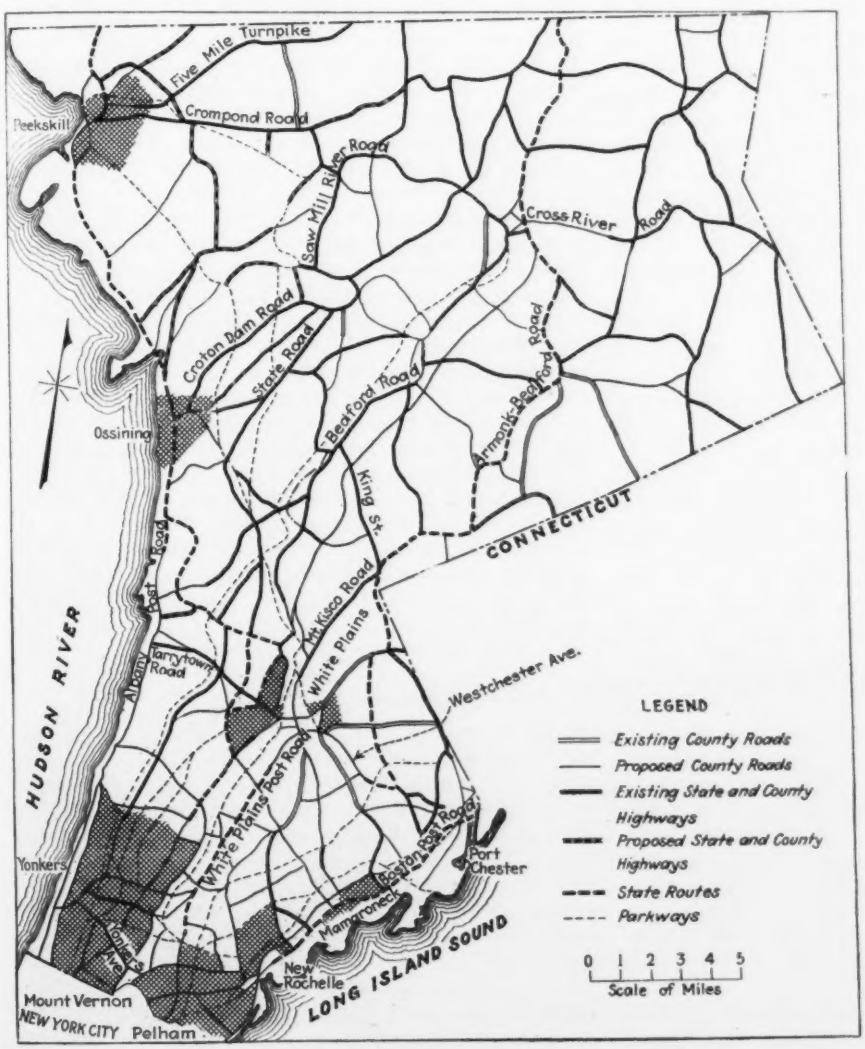
south ridges and valleys traversing Westchester County. Breaks in these ridges occur at infrequent intervals. Yonkers Ave., not far north of the southerly boundary of the county, finds a continuation through Mount Vernon to New Rochelle through the most closely built up section of the county, with many intersecting streets. From this section there is a 10-mile interval northward to the next natural east and west through route from Tarrytown by way of White Plains to Port Chester. From Peekskill, 15 miles farther north on the Hudson River, a main highway route extends nearly due east to the Connecticut boundary.

From a regional standpoint these three north-south and three east-west routes may be regarded as the main or trunk framework for mixed traffic. They are interconnected by an extensive network of secondary highways and are paralleled in some sections by somewhat disjointed stretches of first-class roads merging into and from the main trunks. To this main and secondary network are tied the city and village street systems, none of them planned in the modern sense of the word but largely laid out by real estate developers in disjointed, gridironed tracts, seldom fitted to the topography.

Since 1921 an actively sustained program or reconstruction to modernize what originally was a typical rural road system has been carried on, resulting in about 400 miles of modern roads, of which more than half are of concrete. At the beginning of this program the older 12- and 16-ft. roads were made 20 ft. wide. Within the past two years considerable mileage of 30- to 40-ft. pavement has been laid and 60-ft. pavement on a 90-ft. right-of-way is now regarded as the desirable minimum of the main trunks.

This highway program thus far has been kept within the limits of tax budget appropriations. The state gasoline tax enacted in 1929 affords a practically negligible benefit to Westchester County, because its distribution to counties is based on mileage of unimproved roads, of which Westchester has only nine-tenths of 1 per cent. With 5.2 per cent of the total automobile registration of the state, the prevailing public sentiment is that both the gas tax and the state highway bond issue funds should be apportioned on the basis of this registration, which would give a much larger share to the county.

The Board of Supervisors has recently adopted an official state and county highway map on which a future ten-year highway program is laid down. The highway system is under the executive supervision of Charles MacDonald, county engineer, reporting directly to the Board of Supervisors.



HIGHWAY SYSTEM OF WESTCHESTER COUNTY

During the past three years studies of estimated future requirements for the whole county and active construction progress have been made on a comprehensive program embracing trunk sewers and sewage-treatment plants. Before this, the Bronx Valley sewer was completed in 1912, serving the various local municipalities from North White Plains southward to Yonkers. Of the ten other separate drainage projects laid out, there is immediate necessity for five in the more closely populated section of the county south of Tarrytown and White Plains. One of these has already been completed, two others are under construction and the remaining two will be undertaken in the near future.

Westchester County's sanitary drainage program is entirely self-contained. The Bronx River and the Hutchinson River valleys continue south of Westchester to Long Island Sound through the Borough of the Bronx of New York City. But an intercepting outfall tunnel leads the Bronx Valley sewer through Yonkers to the Hudson River and is of sufficient size to carry the flow of the Hutchinson Valley sewer, now under construction, with one treatment plant for the combined flow.

With the exception of the Bronx River and the Hutchinson River, all other drainage areas in the county are tributary either to the Hudson River or to Long Island Sound within the limits of Westchester County, with the further exception of sparsely settled areas fringing the Connecticut boundary in the northerly part of the county. The five projects above referred to are the Blind Brook, which is completed, the Mamaroneck, Hutchinson, upper Bronx and Saw Mill Valley projects, all of which are scheduled to be completed or well advanced within the next three years. The total cost of this program, including treatment plants, will be about $22,000,000, which will be distributed in long-term assessments against property within the areas benefited.

The administrative authority is the Westchester County Sanitary Sewer Commission, appointed by the Board of Supervisors under authority of the state legislature. This commission consists of three members serving without compensation. The commission's engineering work is under the general direction of W. W. Young, consulting engineer.

Water Supply Problem Common to New York City

The problem of water supply for the Westchester County region is interlocked with that of New York City by reason of the fact that the city pre-empted Westchester County's most important source of water supply in the Croton River development, beginning with the old Croton dam and aqueduct in 1842 and attaining the ultimate economical limit through the Croton Falls and Cross River reservoirs, completed in 1908. The headwaters of the Bronx River, another Westchester source, are also impounded for the city's use by the Kensico reservoir, which in addition stores a large supply of Catskill water. The Croton aqueducts and the two Catskill aqueducts pass through Westchester, and future aqueducts to the city must also pass through this region.

The Westchester region is now served by fifteen municipally owned plants and eleven privately owned corporations. These plants derive their supplies from seventeen surface sources, nine separated groups of wells and springs and from New York City's Croton and Catskill aqueducts. The rapid building up of the area south of Tarrytown and White Plains has made the sanitary protection of watersheds in that area increasingly difficult and land values will soon force the utilization of vacant watershed areas for other purposes. The abandonment of these surface sources is presaged in the not distant future and is already under way on the Hutchinson River, where one reservoir in Mount Vernon has already been abandoned. Two others were sold to the Westchester County Park Commission in 1927 subject to water-supply use for five years, after which they will become park lakes.

As to sources, the main possibilities for meeting the future water-supply requirements of the Westchester region lie in further drafts on New York City's aqueducts or in developing the streams north of Westchester and tributary to the Hudson River from its easterly side. The present trend is to purchase water from the city aqueducts and regional action by the Westchester authorities has been limited to negotiations as to the delivery price to various distribution systems owned either by the local municipalities or by private water corporations which still hold franchises.

For several years past various local municipalities have purchased water from the city at the rate of $133 per million gallons, to which was added the cost of local distribution. Incidental to New York City's proposal to build another aqueduct from the headwaters of the Delaware easterly across the Hudson River and thence through Westchester territory, the county authorities started negotiations for a lower rate. At the end of 1928 an agreement was reached on a price of $100 per million gallons for Catskill water and $66.66 for Croton water, the latter being under a lower head. These rates represent the mean costs of collection and delivery at points along the aqueducts within Westchester County.

Airports

For the reason that there are areas conceivably adaptable for airport uses in the county park reservations already established, the county government authorities have drafted the Westchester County Park Commission to make a study and a report on the essential features of location, design and operating conditions of the principal air fields and seaplane bases both in the United States and in Europe. When completed, this report will guide the formulation of a policy toward possible aviation facilities if established under county governmental auspices.

Recapitulation

This discussion of Westchester County's regional problems has not been confined narrowly to engineering aspects but rather to direct the trend of thought toward the political and administrative limitations which often hamstring the application of planners' and engineers' resources already well developed and matters of common professional knowledge. Westchester County's progress on her regional problems is largely measured in terms of a conspicuous absence of those limitations.

Every large city and its related areas of regional growth constitute an individual problem not only as to physical characteristics but also in the varying political, economic and social aspects. No formula can be given for the translation of abstract planning into effective accomplishment. It is, however, well known that the progress of any municipality in meeting the complex requirements of modern living conditions and particularly the concentrated mechanized complications of the growth and spread of modern cities lies largely in the quality of citizenship, whether it supports and demands progressive administration and whether the administrative officials measure up to their responsibilities. Through these attributes Westchester County has converted a substantial program of regional planning ideals into practical realization and has provided stimulus for progress in many other regions.

Reclaiming the Chilean Nitrate Desert

Plans to irrigate portions of the nitrate region in the Atacama Desert by extensive works which will supply water to about 60,000 acres of land are being formulated by the Chilean government. Nearly all the food supplies for this district are at present obtained from central Chile and Argentina, but it is believed that parts of the Atacama Desert can become practically self-supporting. It is proposed, by constructing dams and canals, to make use of the waters of the rivers in northern Chile that are at present lost in the hot sands of the desert. The Chilean government has allocated more than £4,000,000 for irrigation projects, and one-half the amount will be spent on work that is planned to be carried out in northern Chile.

All-Metal Hangars at a Cost of $1.10 Per Square Foot

At Grand Central Air Terminal, Los Angeles, 100-Ft. Roof Trusses Eliminate Interior Columns—Doors in 20x20-Ft. Sections

IN PLANNING the Grand Central Air Terminal at Los Angeles so much hangar space was needed that particular attention was given to working out an effective and inexpensive design which could be used as standard. To May 1 a total of 1,290 lin.ft. of hangars 130 ft. wide had been built at this airport, and more of a similar design are to be built as additional facilities become necessary. The construction, which is of fireproof materials exclusively, includes 100-ft. steel trusses with galvanized-iron roofing, all supported on a structural steel frame. Including concrete floor and underground drainage system, the total cost for these structures has been between $1 and $1.10 per square foot of floor area.

In accordance with the usual custom in southern California, the design of the roof trusses includes no snow load, but in addition to dead load an allowance of 25 lb. per square foot was figured for live load, and provision was made for a 20 lb. per square foot wind loading. In the first hangar, column footings were designed for a 4,000-lb. per square foot foundation loading. Subsequent tests showed that while this load was within safe limits, the margin on the very fine silt soil was close; therefore in the structures built later foundation loading was decreased to 3,000 lb. per square foot by proportionally increasing the footing sizes.

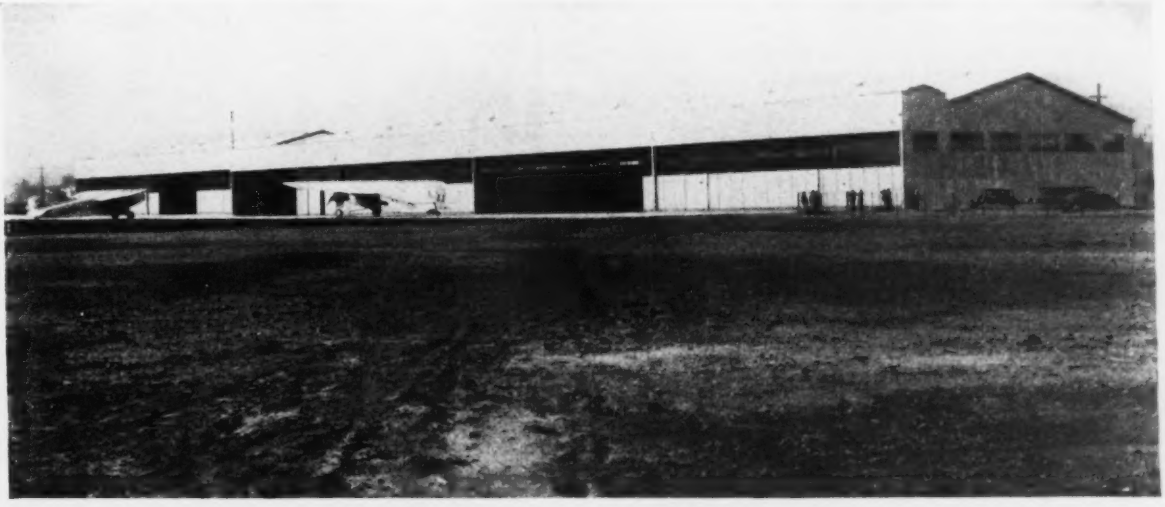
The roofing material is corrugated galvanized iron, this material being considered quite dependable for long service in a belt free from fog. Standard 36x144-in. sheets were used on sides and roof, the thickness on the roof being 24 gage and on sides and ends 26 gage.

The first hangar was built with door panels 10 ft. wide by 20 ft. high. With the mountings used it was found that one man could easily push along three or four door sections at a time; therefore the panels in all later hangars were made 20x20 ft. in size. The steel columns that support the roof on the airport side of the hangars are 100 ft. apart in all of the hangars except that built for the Transcontinental Air Transport, which has the column supports 120 ft. apart. The door openings for this hangar are also slightly higher than the others, being 22 ft. in the clear. Each door panel is provided with two malleable iron, double flanged wheels, 11 in. in diameter, equipped with roller bearings and pressure lubrication fittings and operating on 16-lb. rails. The top of each door panel is held in place by two guide rolls 6 in. in diameter.

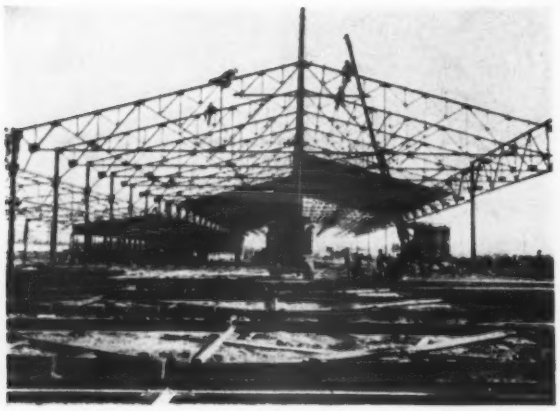
INTERIOR VIEW OF COMPLETED HANGAR
Note firewall in background, sliding doors at right and absence of columns.

The floor slabs, which were put down after the superstructure was erected, consist of a 4-in. layer of $1:2\frac{1}{2}:3\frac{1}{2}$ concrete laid in 100-ft. squares and sloped toward the center. The central drain in each square is set 8 in. below the edges; thus the entire floor can be hosed off when desired. The drains discharge into a storm drain system which also carries roof drainage as well as some drainage from the ground near the building. The concrete area immediately in front of the hangar slopes away from the building, so there is drainage both ways from the doorsills.

To give fire protection to lessees of space independently of risks in adjacent space leased to other operators, firewalls consisting of transverse brick partitions are put



GENERAL VIEW OF ONE OF THE HANGAR UNITS
Daylight is admitted through windows on all four sides. Area immediately in front of hangar is concrete paved.



ERECTING 100-FT. ROOF TRUSSES WITH TRUCK CRANES
By fabricating the entire truss at the steel plant, they were erected speedily with a minimum of field riveting

in between major divisions of the hangars. These walls are not included in the $1 to $1.10 per square foot cost figure. The builders of these hangars have stated that the design is such as to keep the construction cost down to approximately the price per square foot that is ordinarily required for framed timber construction. This affords, at no increase of cost, the considerable advantage of reduced fire risk and long life that goes with all-steel construction.

The hangar design is part of the airport development worked out by C. C. Spicer and C. A. Spicer of Los Angeles, the design and supervision of construction being under the direction of C. A. Spicer.

Tall Bridge Pier Construction in an Engine Roundhouse

Unusual Problem Successfully Solved in Building Approach to Detroit River Structure

By Phil A. Franklin
Engineer of Design, McClintic-Marshall Company, Pittsburgh, Pa.

AN UNUSUAL problem of bridge pier design and construction incident to building the United States approach to the new Detroit River suspension bridge was occasioned by the fact that one pier was located between two engine pits of a roundhouse of the Pere Marquette Railroad, over whose yard the approach passes. The location of the pier is indicated in Fig. 1 by the holes cut in the roof of the roundhouse. Briefly, the pier (No. 2 in Fig. 3) consists of two structural steel bents, one on top of the other and separated by a pin-bearing detail. The lower bent is unusually heavy and rigid and extends from the foundation to several feet above the roundhouse roof. The top bent is a conventional cross-braced frame and carries the trusses of the bridge approach. By this design, bridge movements due to expansion, wind or other causes cannot be transmitted to the roundhouse structure.

Design—Several special factors affected the design of this roundhouse pier. The bridge approach consists of a series of truss spans covering some 800 ft. supported by two-column bents fixed at both the top and the bottom. There is no bracing between the bents, the only points of anchorage against longitudinal movement occurring at the ends of this series of trusses at the main cable anchorage and at a braced tower placed just landward of the main suspension-span tower. All expansion is taken care of on pier 3 just outside of the roundhouse, so that the expansion of something over 350 ft. of the approach truss length (calculated to be about $1\frac{1}{8}$ in. movement each way from normal) is thrown into pier No. 2. It was desired that this movement should not be transmitted to the roundhouse. A second factor affecting the pier design was the requirement for as much clearance as possible in the roundhouse.

Because of constricted working space, the nature of the underlying soil, the distance to rock, the very short time allowed for construction and the surrounding structures which it was necessary to protect, the footings for piers 1, 2 and 3 were constructed by the Chicago well method as described in *Engineering News-Record*, Dec. 6, 1928, p. 830. Each of these footings consists of two reinforced-concrete shafts 8 ft. 3 in. in diameter by 60 ft. deep, spaced 45 ft. apart.

The dimensions and arrangement of the roundhouse pier are shown by Fig. 3. The width of the bent is 45 ft., which corresponds to the distance from center to center of bridge approach trusses. The total height of the lower bent from the under side of the base plate to the center line of the rocker pin is 49 ft., of which 12 ft. $11\frac{5}{8}$ in. is buried in the concrete shaft. In order to preserve the maximum working space around the engines, all transverse bracing was eliminated for a height of 18 ft. $3\frac{3}{4}$ in., at which elevation a heavy strut was placed between the two columns of the bent. This made a fixed portal of the portion from the strut down and left a part of the columns extending unsupported above the cross-strut as cantilever. The upper or rocker portion of the bent above the pin is of conventional crossbraced design and presented no unusual features. As shown by Fig. 3, the new steel bent provides for the support of many of the appurtenances in the roundhouse.

To eliminate the necessity of inspection and painting, the bent within the roundhouse was covered with a 2-in. coat of gunite as shown by Fig. 2, and an additional 2-in.

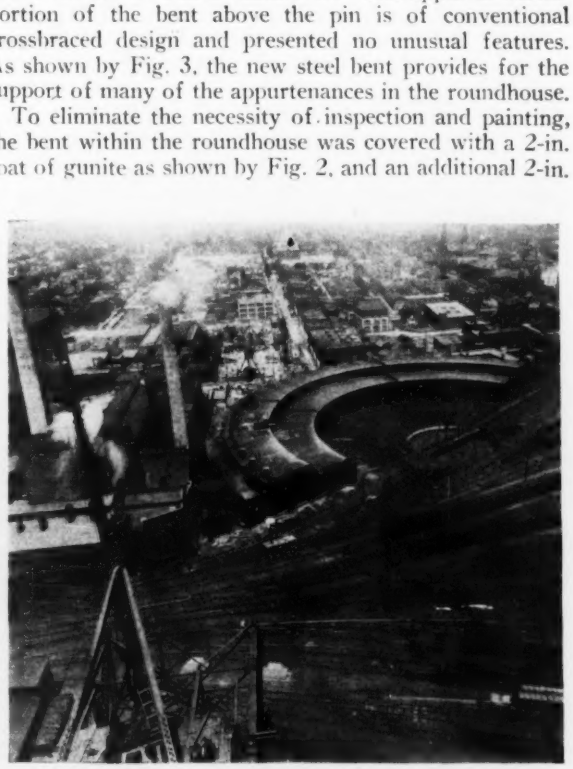


FIG. 1—LOCATION OF BRIDGE PIER IN ROUNDHOUSE
Looking along the center line of the Detroit River suspension bridge approach, showing holes cut in the roundhouse roof for the construction of one of the approach piers.

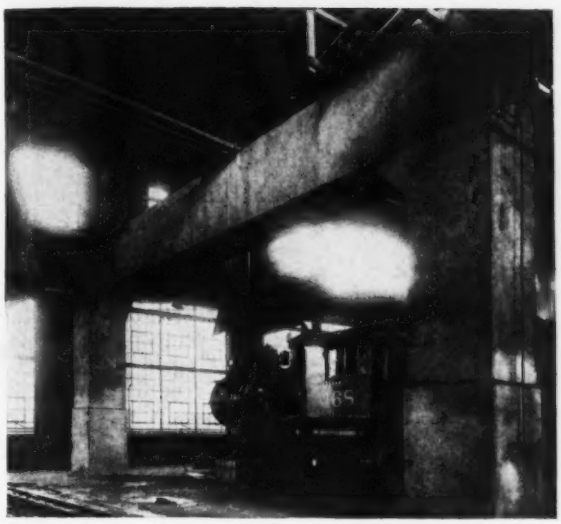


FIG. 2—COMPLETED PART OF STRUCTURAL STEEL PIER IN ROUNDHOUSE
Note additional layer of gunite around lower part of column as protection against collision.

layer of gunite was used for a height of 7 ft. above the floor to provide additional safety in case of collision by shop equipment; this outside coat of gunite has its own layer of reinforcement. The gunite covering is also carried above the top of the structural steel of the column sections to provide a pocket for the asphalt protection around the pin.

The maximum vertical load, 1,572,000 lb., is on the east column of the bent and included those loads from the roundhouse which are supported directly on the main columns. The load near the center of the cross-strut is 24,000 lb., occasioned by the center column of the original three-post bent of the roundhouse. By carrying this center column on the new steel cross-strut, an unobstructed horizontal distance alongside the engine pits of about 41 ft. is provided instead of two spaces of 20 ft. each as in the original construction. The horizontal wind load which is applied at the pin is 80,300 lb. at each column top.

Erection — Preliminary to the construction of pier 2, the railway company discontinued the use of the engine pits adjacent to the footing. Timber posts supporting the roundhouse roof were then removed, holes were cut in the roof for the bent to pass through, and the adjacent part of the roundhouse structure was carried on temporary supports until it could be transferred to the new steel bent. In constructing the footings, the concrete was poured up to El. 572.8, 13 ft. below the roundhouse floor, at the same time allowing the reinforcing steel of the lower part of the shaft to extend 4½ ft. above this elevation. The steel columns were set, the cross-struts were placed and the assembled bent was riveted. Reinforcing was then placed and the concrete completed for the shaft and for a concrete cross-strut connecting the shaft just below the roundhouse floor. The reinforcement of the concrete shafts from the bottom up to about 11 ft. below the base of the column was used merely for safety against side forces below ground not susceptible of calculation. At that point the reinforcing from below, together with the vertical reinforcement from the upper portion of the shafts and that in the concrete cross-strut, was proportioned to take the bending at the base of the steel bent and transfer it into the rigid frame formed by the concrete shafts and cross-strut. The resulting rigidity, together with the use of the transverse pin across the column above the roof of the roundhouse, effectively insulates the roundhouse from bridge approach movement.

The work was done in about 90 days by H. H. Esselstyn, Inc., Detroit, Mich., as subcontractor under the McClintic-Marshall Company, of Pittsburgh. Jonathan Jones, assistant chief engineer, Robert MacMinn, engineer of construction, L. L. Martin, resident engineer of erection, and A. H. Toohey, erection foreman. R. G. Cone was resident engineer for the consulting engineers, Modjeski & Chase.

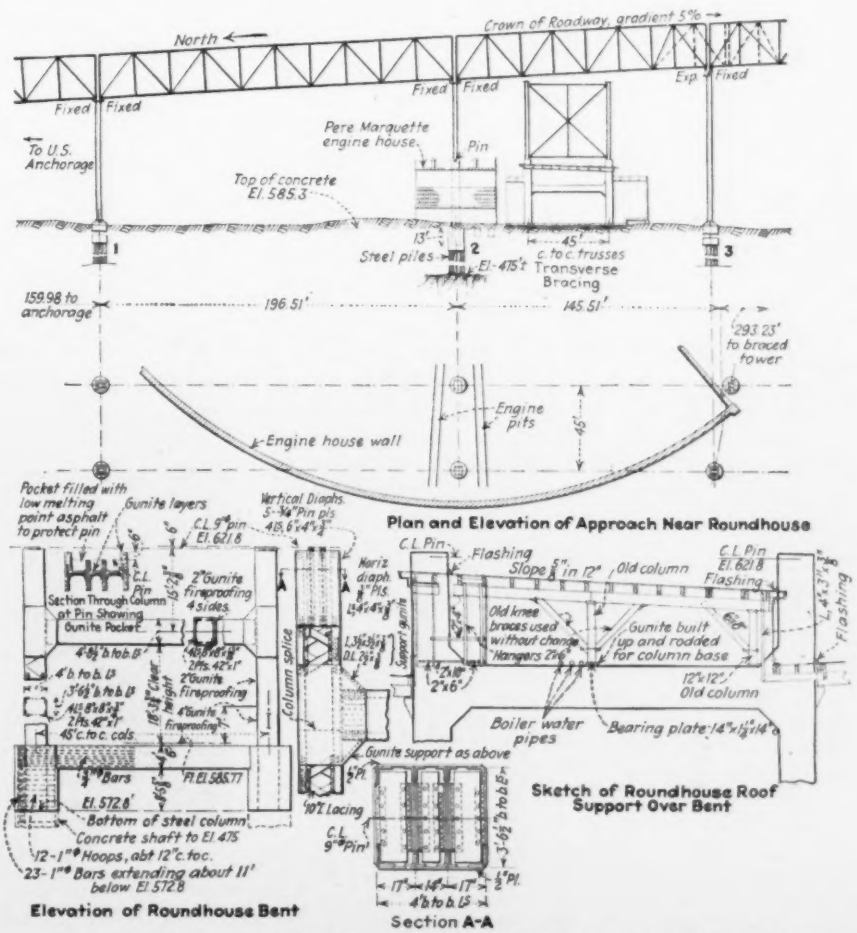


FIG. 3—DETAILS OF BRIDGE PIER CONSTRUCTED IN ENGINE ROUNDHOUSE

Heavy Foundations Built Under an Occupied Basement

Reconstruction of Department Store Advanced Four Months by Sinking Underfloor Pits and Concreting Footings Ahead of Wrecking Operations and General Excavation

By W. T. McIntosh
Engineer, Spencer, White & Prentis, New York, N. Y.

BY INSTALLING the foundations for the new building before demolishing the old one remarkable speed has been made in constructing the twelve-story department store for Abraham & Straus, Inc., in Brooklyn, New York City. Construction of the foundations was begun in July, 1928, the work being done in the basement of the old building while the store was in operation. The part of the store under construction was closed Jan. 7, 1929, and on July 5 two stories were available for selling goods, and the substructure, steel frame, floor arches and brick walls were virtually completed for all twelve stories. The whole building is to be ready for occupancy Oct. 1, 1929, or nine months after wrecking the old building was begun.

As laid out the new Abraham & Straus store will be 300x400 ft. in plan and twelve stories high. It is being built on a site long occupied by the old store and on adjoining land recently acquired. To reduce interference with business a first section, covering 40 per cent of the area, is being built, to be followed when completed by a second and a third section, each of 30 per cent of the area.

General Construction Procedure

The accompanying sketch indicates the type of foundations and the procedure followed in installing them. Briefly, the foundations are reinforced-concrete spread footings on coarse sand at a depth of from 44 to 52 ft. below the street. The column spacing is from 24 to 30 ft. and the column loads run up to 1,200 tons. The general excavation averages about 42 ft. below the street.

In order to save the time required for excavating and installing foundations in the usual manner, it was decided to place partial footings in pits sunk from the basement floor of the old building while that building was in operation, so that the steel billets and columns for the new building could be installed in the pits as soon as the building was vacated and wrecked. Then, while erection of the superstructure progressed, the general excavation was to be taken out and the spread footings were to be enlarged to their full size. This program was successfully followed and the entire four months which would normally be required for excavation and foundations were thus saved.

Three shifts were worked. About 90 per cent of the work installed before the wrecking was begun was done in the basement of the old building 12 ft. below the street, occupied as a "bargain basement store." At all times this was the most crowded part of the store and it contributed a large share of the profits of the business.

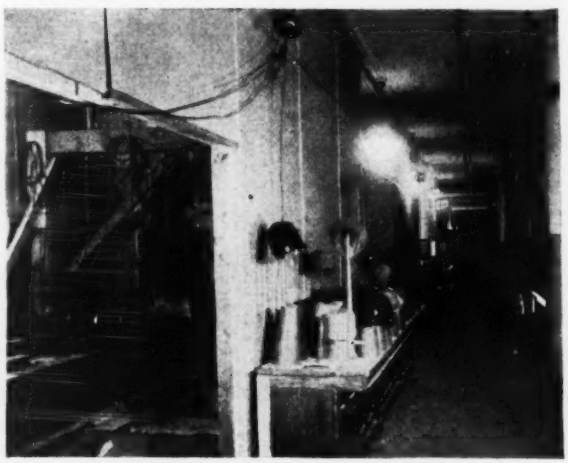
Small areas of this floor were occupied successively by the foundation contractors, beginning July 1, 1928. In general, on each Saturday night an area about 35 ft. square was inclosed with temporary partitions. Within this inclosure pits were sunk for temporary footings for four columns, and the footings were concreted in the pits during the week. On the next Saturday night the floor was restored over the pits, the temporary partitions were removed and the space was again available for selling goods. This program was repeated throughout the area until all temporary footings were completed in December.

The underpinning of adjoining structures was done in similar manner. A narrow passageway along one side of the basement was partitioned off as the work progressed, to give access to one after another of the working spaces. Some of the spaces could not be reached without extending this passageway through valuable selling space. In such cases sufficient equipment and materials were put into the inclosed space before the store opened each morning to last until the store closed, and muck from the pits was piled up within the space. After the store closed at night, panels in the partitions were removed and access through the selling space was had until the next morning.

Constructing Column Footings in Pits

To install in pits spread footings of sufficient size to carry the ultimate column loads would have made the pit dimensions prohibitive. Instead, temporary footings were installed large enough only to carry the steelwork, the floor arches and a part of the brickwork. While these parts of the superstructure were being erected, the general excavation was made and the footings were enlarged to sizes required by the ultimate loadings.

The excavation of a pit for a typical interior footing was begun at the existing basement floor and carried down 38 ft.; footings adjoining elevator pits were 4 ft. deeper. The pit was 7 ft. square to a point about 3 ft.



TYPICAL WORKING INCLOSURE TEMPORARILY ERECTED IN BASEMENT STORE
Part of partition removed to show proximity of work to selling space. New column pit being excavated under old column carried on needles.

above the top of the billet, from which point it belled out to provide ample clearance for setting of the billet, and at a lower point belled out further to provide the required footing area.

Part of the old store building had no basement, the first floor being on the ground. In this part it was necessary to drive short tunnels out from the adjoining basement, enlarge chambers at the ends of the tunnels and sink the pits from these chambers.

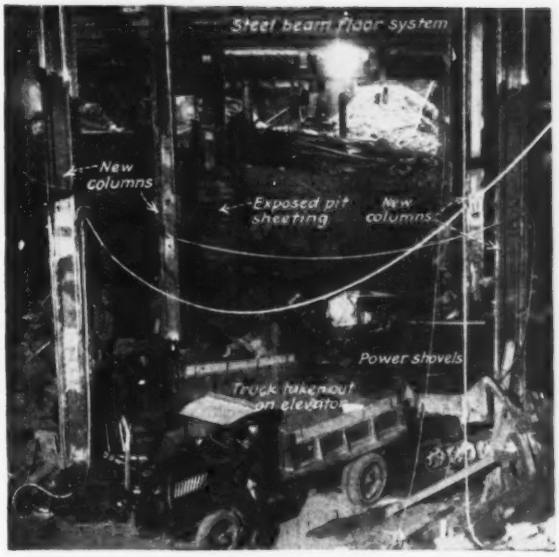
The building line column footings were oblong instead of square, and in practically all cases were under columns, piers or walls of the existing building. The pits of these columns were sunk nearly square and belled out on three sides in sinking, the fourth side being carried down straight. After reaching bottom, the fourth side was drifted out to the required size.

In many cases the locations of columns for the new building coincided with those of columns or piers of the existing structure. It was then necessary to carry the existing columns or piers on needle beams and sink pits under them. Steel I-beams on timber mats were used for this purpose. After the pits had been sunk and the concrete footings poured, timber posts were carried up from the concrete to the column or pier bases and wedged to take the load. The needles were then removed, the floors were restored and the floor space was again used for selling goods. The loads on the columns and piers ranged from 80 to 150 tons.

In some parts of the basement the space available for needling was greatly reduced by elevators, steam header lines, ducts or other equipment which required to be kept in regular operation. In such cases multiple needling and cantilever needling was resorted to.

The ground material was coarse gravel and boulders in the upper 20 ft., with gravel and coarse sand below. The boulders were an extremely hard, close-grained rock and ranged up to 12 ft. in diameter. It was necessary to break these down with plugs and feathers, since dynamite could not be used inside the store. The gravel and sand were loosened with compressed air spades. All muck was hoisted to the basement floor with electric winches and caisson buckets. Pits were sheathed horizontally with 3- or 4-in. sheathing, cross-braced on long spans.

Muck from the pits was transported in ½-yd. gasoline-driven, three-wheel, dump-body trucks to a self-dumping bucket elevator, electrically operated, mounted in one of the freight elevator shafts of the existing building. This elevator discharged into a sloping bottom muck bin over the sidewalk, from which the excavated material was discharged through a specially designed gate into motor trucks on the street. The volume of muck removed from foundation pits and underpinning pits was approximately 8,000 cu.yd.

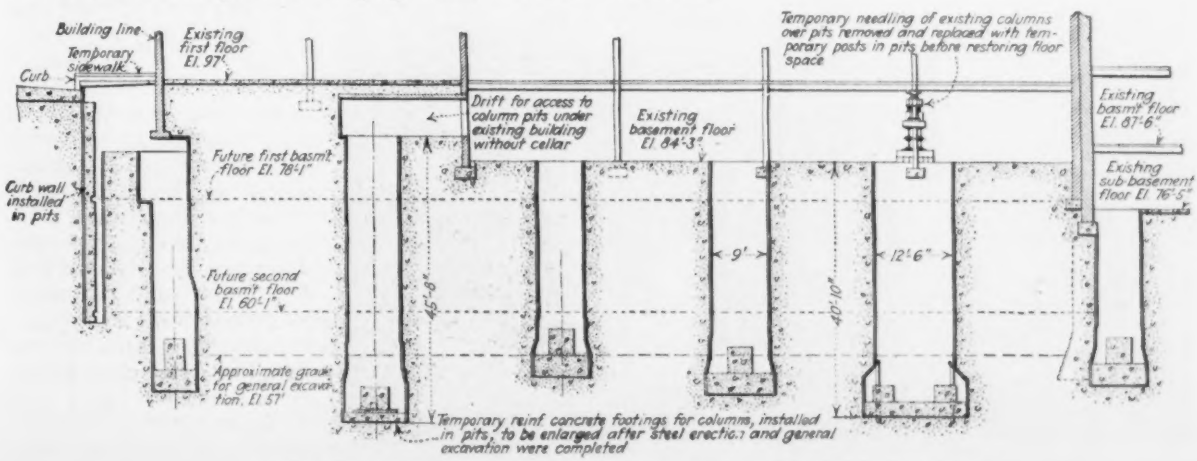


SHOVELS AND TRUCKS TAKING OUT GENERAL EXCAVATION

All concrete in column footing pits, underpinning pits and curb wall pits was bought from a commercial mixing plant and transported in revolving trucks. It was chuted through the sidewalk to a hopper on the basement floor, loaded into the three-wheel gasoline-operated dump trucks and transported to the pits and there dumped into wide-mouthed hoppers feeding into round spouts.

Underpinning and Curb Wall Construction

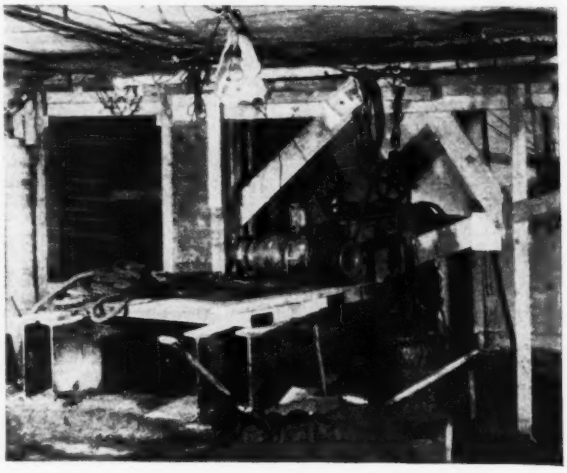
Two adjoining buildings, a total of 270 lin.ft., required underpinning to a depth of from 40 to 48 ft. Also, the portion of the existing store which was not to be wrecked for the first-section operation required underpinning to the same depth. This is a six-story and basement building (part with second basement), the length of adjoining wall being 320 ft. Part of this wall is a series of arches and piers carrying about 100 tons each.


Building line
Existing first floor El. 97'
Temporary Sidewalk
Curb
Curb wall installed in pits
Future first basmt floor El. 78'-1"
Future second basmt floor El. 60'-1"
Approximate grade for general excavation, El. 51'
Drift for access to column pits under existing building without cellar
Existing basement floor El. 84'-3"
Temporary needling of existing columns over pits removed and replaced with temporary posts in pits before restoring floor space
Existing basmt floor El. 87'-6"
Existing sub-basement floor El. 76'-5"
9'
12'-6"
45'-8"
40'-10"
Temporary reinf. concrete footings for columns, installed in pits, to be enlarged after steel erection and general excavation were completed

TYPES OF FOUNDATION OPERATIONS UNDER OCCUPIED BUILDINGS

The underpinning was installed in alternate pits, usually 3x6 ft., sunk in the same manner as the column foundation pits. Shoring and needling were installed where required for maintaining the walls and especially the piers, while the pits were being sunk under them. I-beam wedging columns, steel plates and steel wedges were used to transfer the load to the underpinning concrete.

On two streets the exterior walls for the new building were built on the curb line. The sidewalk was removed and replaced by a temporary wood sidewalk on timbers. Working under this, an 80-ft. deep excavation was made from the foundations of the existing building to the curb line. From this excavation, alternate pits 3x6 ft. were sunk on the curb line to the depth of the wall footing, 38 ft. below curb, in the same manner as were the column pits. The reinforced-concrete curb wall was installed in these alternate pits.



NEEDLED BRICK PIER WITH PIT EXCAVATING OUTFIT

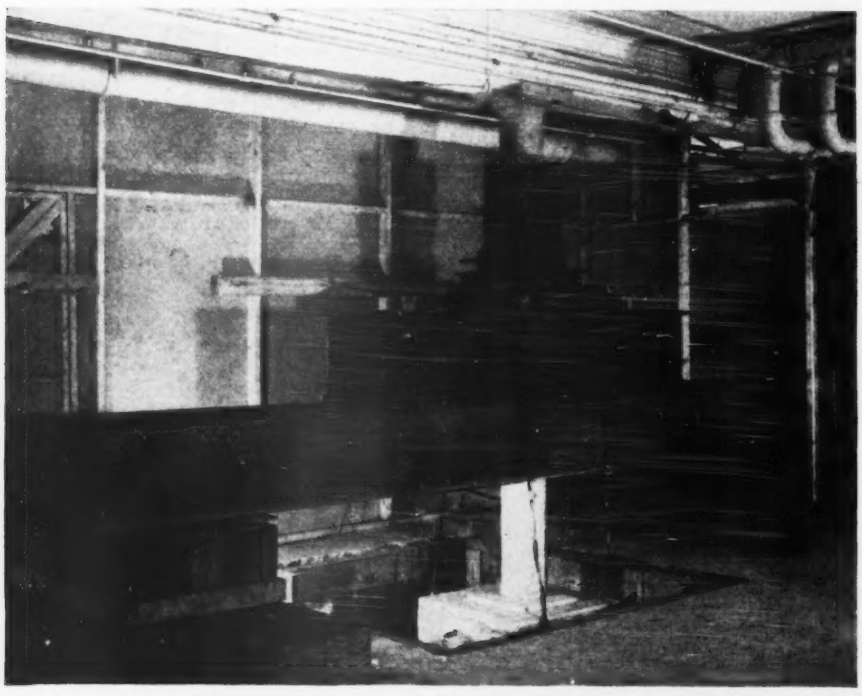
Methods of Steel Erection

On Jan. 7, 1929, the old building was completely vacated, the selling departments being compressed into the part of the store which will not be wrecked until the second and third sections are built. In the next 21 days the old six-story building was demolished by the general contractors. By that time all temporary footings and all underpinning had been completed.

Covers were then removed from the column-footing pits by the steel contractor. Billets and grillages were lowered and set in place, and single-piece columns reaching to 2 ft. above the first floor were lowered into the pits and bolted to the billets and grillages. The first-floor steel was then set and riveted and covered with scaffold planks. In the meantime a timber ramp had been built from the street to the basement floor of the wrecked building.

As soon as the steel contractors had jumped the derricks to the second floor, four electric shovels were run in on the basement floor and general excavation was begun. One of the shovels was a standard $\frac{5}{8}$-yd. shovel, while the others were $\frac{1}{2}$-yd. shovels designed especially for operation in small space underground. In the early part of the excavation the shovels loaded into motor trucks running in and out on the ramp.

While the shovels were working down to about 10 ft. above final grade, an electrically operated truck elevator was installed. For this purpose the first, second and third floors were omitted in one bay and the elevator was installed on the steel frame of the building. The elevator cage was designed by the foundation contractors to handle standard motor dump trucks and the small electric shovels. It was 25 ft. long and 12 ft. wide and was built to hoist or lower 40,000 lb. at a speed of 100 ft. per minute. The cage traveled on 12x12-in. timber guides and was equipped with four cast-steel safety dogs, acting automatically in case of a break in the hoisting cable. The hoist was a single fixed-drum electric hoist, mounted over the cage on the third floor, manually operated from a hoist house on the first floor. The cage and the live-load counterweight were carried on four-part lines to the hoist drum. The dead-load counterweight was on a single part line over idle sheaves.



NEEDLES CARRYING OLD COLUMN OVER NEW FOUNDATION

As soon as the elevator was in operation all muck trucks ran in and out on the cage and the timber ramp was removed. The elevator was also used for delivering concrete materials and other materials to the job and for removing the three electric shovels when their work was completed.

When the general excavation had been carried well below the first basement floor level, the steel contractors placed the first basement floor steel and the floor arches

were poured. This acted to brace the curb wall and underpinning and avoided the use of cross-lot bracing. The excavation had progressed meanwhile, but berms were left until the first basement floor arches had set and were then removed.

The general excavation was substantially completed in 40 working days, the shovels operating two nine-hour shifts per day, the volume being approximately 45,000 cu.yd.

Boulders and blocks of masonry which were too large to be handled by the shovels were loaded on trucks by a gasoline-operated truck crane. Elevator pits and permanent footing excavations were made with the truck crane and bottom-dump buckets, loading into motor trucks.

Permanent Footings

As soon as general excavation was completed in one part of the site excavations were made for the permanent footings for columns, reinforcement was placed

BOTTOM OF FOUNDATION PIT SHOWING BRACING AND TIMBERING

This pit is 5x12 ft. and 34 ft. deep. Note belled out far end to give footing 5x20 ft.

and the footings were concreted. In general, the permanent footings were enlargements of the temporary footings. In the case of columns along adjoining property, however, it was necessary to install cantilever footings under the temporary footings of the exterior wall and the next interior row of columns. This was accomplished by successively drifting under the temporary footings in narrow strips, temporarily supporting the load by the patented protest wedging method, and casting the strips of reinforced-concrete combined footings.

Concrete for the permanent footings was mixed in a central plant on the first basement floor, hauled on that floor in the gasoline motor dump trucks and dumped into a movable hopper feeding chute which carried it to the required location in the bottom. The concrete mixer was fed from material bins hung from the first floor, into which material trucks dumped the sand and stone.

Completion

The foundation work was substantially completed on April 30, less than three months after the wrecking of the old building. On that date all steelwork, floor arches and about 90 per cent of the exterior brickwork of the new building had been completed, and plastering, finishing of floors and work of other trades were well under way. Fully four months' time was thus saved over the usual method of construction.

The building was designed and is being erected under the direction of Starrett & Van Vleck, architects. The consulting engineers were Purdy & Henderson. The general contractor was Starrett Bros., Inc., and the foundation contractor was Spencer, White & Prentis, Inc.

Uniform Accounting Urged for Sewage-Works

ACTUAL costs of construction and operation of sewage-works being highly important, it is desirable that they should be recorded on some uniform system to permit comparisons among different plants, for which reason a standardized system of cost accounting was advocated by G. H. Radebaugh, manager of the Urbana-Champaign Sanitary District, at the recent annual meeting of the Central States Sewage Works Association. His own district issues complete annual reports of the finances and operation, together with a yearly audit by a public accountant. Its accounting system includes the budget method and a monthly balance sheet; all expenditures are charged to specific accounts established by the tax levy ordinance, voucher checks are signed by two officers of the board and the treasurer, and no accounts are paid unless an itemized invoice is made out. A monthly financial statement is made to the board by the treasurer.

An analysis of expenditures showed that for the year 1925-26 the cost of plant operation was 42c. per capita and the total cost $1.74 per capita. For 1927 the figures were 48c. and $1.62, respectively; for 1928 they were 35c. and $1.54; and for 1929 they were 38c. and $1.53. These figures include bond interest, bond retirement, new construction, engineering and legal fees, plant operation, labor and every expenditure incurred. But comparison with the costs given by two other districts serving about the same population showed the Urbana figures to be more than 50 per cent lower. This does not mean necessarily bad management on the part of these two districts, but it does indicate that their systems of accounting are different. The question of comparative cost is important and a standard code of accounting would enable an intelligible and fair comparison to be made. Such correct accounting would help to destroy opportunity for attack from opponents of sewage-treatment projects on the basis of high cost, while an informed public would not be misled by these attacks.

After the presentation of Mr. Radebaugh's paper, the association adopted a resolution urging the Federation of Sewage Works Associations to appoint a committee to prepare a standard code of accounting, to include both construction cost and operating cost of such projects.

Tests on Concrete Made at Coolidge Dam

Experiments Show the Important Bearing of Certain Minor Factors on Quality

By Bruce Johnston

Formerly Testing Engineer, U. S. Indian Service, Coolidge Dam

THE water-cement ratio theory is in the spotlight at the present time whenever the subject of concrete making is under consideration, and there are a few who deny its importance of practicability when intelligently used. But with so much attention drawn to one principle, one is apt to lose sight of the fact that there are other factors which may under certain conditions have an extremely important bearing on concrete quality. As stated in the Portland Cement Association handbook, the water-cement ratio law is undoubtedly a true principle, but the limiting condition contained in the phrase "for given materials and conditions of manipulation" is hard to obtain in practice. A very slight variation in certain qualities may cause a variation in strength equal to that brought about by a relatively large change in the water-cement ratio.

Preliminary tests made by the Arizona State Highway Department and later tests made at the Coolidge dam in conjunction with the routine work of testing materials have indicated the great importance of the following factors: first, the chemical composition of the water; second, the presence of fine material in the sand, and finally, the order in which the various ingredients are mixed. Each of these is taken up in the following paragraphs.

Water—The water used in making concrete was pumped from a warm springs which issued from the canyon side about a quarter-mile below the dam. In April, 1925, a chemical analysis made by the University of Arizona showed it to contain the following:

	Parts Per Million
Total solids at 110 deg. C	1460
Chlorides as NaCl	745.8
Permanent hardness as $CaSO_4$	0
Permanent hardness as Ca $(HCO_3)_2$	348.3
Sulphates (SO_4)	305.0
Calcium (Ca)	112.5
Magnesium (Mg)	11.3
Nitrate (NO_3)	0

In July, 1926, a sample of the warm springs water was sent to the Arizona State Highway Laboratory and standard concrete cylinders were made up in comparison with city of Phoenix water, with the following results:

	Average 28-Day Strength Based on Three Cylinders
1:2:4 mix, city of Phoenix water, lb. per sq. in.	1425.0
1:2:4 mix, warm springs at Coolidge dam	2122.0
Per cent superiority of warm springs water	48.9

Later tests were made using briquets which were tested at seven days in tension:

Water Used	Sand	Average Seven-Day Tensile Strength	Ratio
Distilled	Ottawa	307	100.0
Distilled	Natural	418	136.2
Gila River	Natural	390	127.0
Warm Springs	Natural	480	156.0

Again the marked superiority of the warm springs water is indicated and it is believed the use of this water had an important bearing on the remarkably high strength averages obtained at the Coolidge dam.

Fine Material—The importance of fine material in the sand used in concrete work was brought out forcibly in several instances. Preliminary tests made at the Phoenix State Highway Department had shown a loss of strength when both the sand and the coarse aggregate were thoroughly rewashed free from any trace of silt.

	Average Seven-Day Compressive Strength 6x12-In. Cylinders
1 : 2.7 : 4.2 mix, aggregate unwashed, w/c. 1.1, lb. per sq. in.	1,427
Same mix, same handling conditions and water-cement ratio, but with aggregate thoroughly washed, lb. per sq.in.	828
Loss through overwashing, per cent	41.9

Probably the real significance of these tests was not in the presence or absence of silt in the coarse aggregate, but the importance which this extremely fine material had on the grading and quality of the sand.

The presence of silt and dirt in the 2½-in. rock was occasionally noted at the start of the work. Dirt in any of the rock was practically eliminated through the installation of more efficiently located water jets in the main rotary screens and the placing of belt washers at return points of all material-conveying belts to prevent drippings of muddy water falling on the stockpiles. At the same time further tests were made to determine the effect of the presence of dirt or silt on the quality of the aggregate.

Order of Mixing—In these tests a stock sand having a fineness modulus of 3.3 and a blending material composed of mud, fine sand and silt, taken from the river-bottom land, were used, together with coarse aggregate which was artificially graded to insure uniformity. A water-cement ratio of 1.05 and a mixture proportion of 1 : 2.8 : 3.5 were used. The blending material was added in two different ways, as outlined below.

Condition No. 1—Sand, blending material, cement and gravel mixed dry in usua manner before addition of water.
Condition No. 2—Blending material and part of mixing water added directly to gravel in order to produce muddy condition in aggregate before use of cement and sand.
Mechanical analysis of blending material:
Organic test, dark brown.
Loss by elutriation, 20.4 per cent
Retained on:

Sieve No.	Per Cent
48	0.0
100	30.6

Test No.	Weight Percentages Sand	Blending Material	Average Slump, In.	Average Seven-Day Comp. Strength 6x12-In. Cylinders Cond. No. 1	Cond. No. 2
1	100	0	2.2	1,240	1,550
2	97	3	1.8	1,470	1,620
3	94	6	1.5	1,400	1,740
4	91	9	2.7	1,620	1,700
5	88	12	1.8	1,510	1,580

Average increase in seven-day strength by use of condition No. 2, per cent ... 13.8
Extreme range in strength, per cent ... 40.3

In the preceding tests the unexpected happened and incidentally an interesting fact was uncovered—namely, that adding part of the mixing water to the gravel prior to the addition of the cement to be used resulted in a marked strength increase. A reasonable explanation of this effect is thought to be that the dry cement adheres to the wet rock and forms a rich mortar which enters the rock pores and increases the bond strength. To check this theory further eight 6x12-in. cylinders were made up and tested at 28 days:

	28-Day Comp. Strength, Lb. Per Sq.In.
Condition No. 1, cement and aggregate mixed dry	2192.5
Condition No. 2, water added to aggregate in part before addition of cement	2587.5

Identical conditions were accurately maintained in every cylinder in the preceding test. Only enough material for one cylinder was mixed at a time, and all of the grades of rock used to make up the total aggregate combination were weighed separately. The results show conclusively that with conditions that prevailed at the Coolidge dam a marked increase in strength, which in

the present case amounted to 18 per cent at 28 days, resulted solely from the use of pre-wet aggregate. In order to take full advantage of this possible added increment in quality the aggregates stored in the bins at the mixing plant were wet down daily during operation.

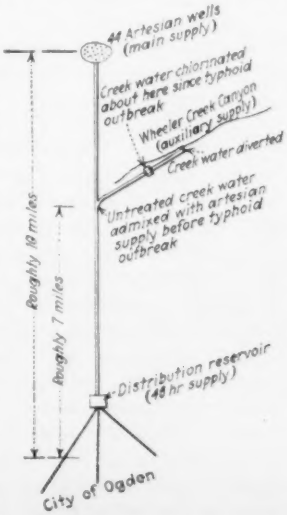
It is possible that the relations that have resulted in the tests which have been outlined were more or less influenced by local conditions, and it would be of interest to see the results of similar tests made elsewhere. In any case, if strength variations amounting to from 20 to 40 per cent can be obtained by slight alterations in material or material handling, too great emphasis on the water-cement ratio and too little emphasis on certain other factors may lead to wrong conclusions and inferior results.

Ogden Typhoid Outbreak Attributed to Public Water Supply

Safe Well Water Supplemented by Untreated Creek Supply Despite State Warning—City Claims Food the Cause

REPORTS on the recent outbreak of typhoid in Ogden, Utah, state that contaminated water from a drainage area frequented by campers and picnickers was entering the city mains without treatment before the outbreak. The state commissioner of health believes that contamination of this supply can be considered the only reasonable source of the outbreak. The report of the U. S. Public Health Service on the water supply and general sanitary conditions also considers the water supply as a very reasonable source of infection, but investigators employed by the city suggest contaminated food from restaurants in the city as the most probable cause. The outbreak occurred during the latter part of June and the first part of July and included nineteen cases, with five deaths. The preliminary report of the state health commissioner was noted in *Engineering News-Record*, Aug. 15, 1929, p. 272.

Most of the water supply for the city of Ogden (population 30,000) is obtained from artesian wells located approximately 10 miles from the city. The quality of the well water has never been questioned. This source, however, is not sufficient during summer months and an auxiliary supply is added from the flow of Wheeler Creek. This water, although originating in springs near the headwaters of the creek, flows through a canyon frequented by hikers and campers. Prior to the time of the outbreak this auxiliary supply was admixed with the artesian water without treatment, at an assumed ratio of one part of creek to five parts of well water. From the junction of these supplies the water flowed to a small distributing reservoir (about two days' supply) and from this point into the distribution system.


44 Artesian wells (main supply)
Creek water chlorinated about here since typhoid outbreak
Wheeler Creek Canyon (auxiliary supply)
Creek water diverted
Untreated creek water admixed with artesian supply before typhoid outbreak
Roughly 10 miles
Roughly 7 miles
Distribution reservoir (48 hr supply)
City of Ogden

SKETCH PLAN OF OGDEN WATER SUPPLY SOURCES

According to the preliminary and the final reports of Dr. T. B. Beatty, Utah state health commissioner, examinations of the Wheeler Creek water by his department had proved it to be contaminated and the city had been urged to discontinue its use or to chlorinate it. The city authorities, Dr. Beatty states, agreed in 1928 to cut out the use of the creek water. He adds that the Utah State Board of Health has no legal authority to stop the use of a polluted water supply. This water was being used during the month of June. On June 10 and 11 and June 16 and 17, rains occurred on the watershed. These rains were followed, after an interim equal to the usual incubation period for the disease, by two distinct outbreaks of typhoid cases. There were no cases of typhoid in Ogden prior to the end of the first incubation period, according to the report, and no cases occurred after the outbreak following the second rain. This evidence the report considers as conclusive that the outbreak was caused by a contaminated water supply. The possibility of milk and food supplies as a source of infection is rated as only a remote possibility.

A report by A. L. Dopmeyer, associate sanitary engineer, U. S. Public Health Service, on the general sanitary conditions at the time of the outbreak, states that the Wheeler Creek water showed contamination and, according to the government standards, was a dangerous source of supply if used without treatment. After pointing to the significance of the rains on the watershed followed by the distinct outbreaks of typhoid, this report, in commenting on the possibility of food contamination, states: "If a typhoid carrier were disseminating the disease in a restaurant, there should be continuous cases of the disease as contrasted with the well-defined outbreak typical of a water-borne epidemic."

Subsequently to these reports bacteriologists employed by the city health department made an independent investigation. Their findings, although condemning the use of the contaminated water of Wheeler Creek and admitting that it was a possible source, suggested contaminated food as the most probable source of the outbreak. They point out that this theory would account for (1) the limited number of cases, which is contrary to what would be expected in a water-borne outbreak; (2) the tracing of all cases to a common possible source of infection, at a certain lunch counter; (3) the high mortality rate, which is uncommon to a water-borne outbreak.

As to the limited number of cases, Dr. Beatty states in his report that in view of the high dilution of creek with artesian water and the likelihood of chance infection by a carrier only a few cases would be expected.

Subsequently to the publication of the report by the city's bacteriologists, Dr. Beatty, on Aug. 24, addressed a letter to the Ogden city commission in which he reviewed the report of the city's bacteriologists and presented data to refute their findings, which ascribed the outbreak to food supply.

Road Work Compulsory in Turkey

A new road law in Turkey provides that all male residents between the ages of 18 and 60, including foreigners who have been in the country more than six months, are subject to road service, which means ten days' work on the roads. In lieu of the work, however, $4 may be paid.

Detroit Flood Hazards From Periodic Lake Rises

Area and Character of 1929 Spring Floods—How Land Development Has Hindered Protection—Requirements of Plan for Permanent Flood Elimination—Protection Urged Preceding Another Peak in Lake Levels

By Louis E. Ayres

Ayres, Lewis, Norris & May, Civil, Hydraulic and Electrical Engineers, Ann Arbor, Mich.

The Water Levels of the Great Lakes rise and fall with approximate periodicity. From peak to peak of high water the time is about ten years. There was high water in 1919 and again in 1929 with an exceptionally low low-water period between. In this period Detroit in its rapid growth spread out over low-lying areas bordering the Detroit River and thought to provide no defense against the high water to come. Thus the high water of 1929 flooded homes and business places and damage was done. This review of lake levels and flood hazards at Detroit is, therefore, of outstanding importance. Their excellent presentation by Mr. Ayres also gives interest to the facts and discussion. —Editor.

THE FLOODING of low areas in and about Detroit during April and May, 1929, which resulted in considerable misleading newspaper publicity, is for two reasons of interest to engineers. First, certain questions of law and public policy and not problems of engineering have been to date and still are the chief obstacles to the permanent relief of the areas involved. Second, rising lake levels, leading possibly to future higher levels, have directed public attention in a new way to the lake level situation.

The area involved in the recent flooding of certain portions of the East Side of Detroit, as shown in Fig. 1, comprises somewhat more than one square mile

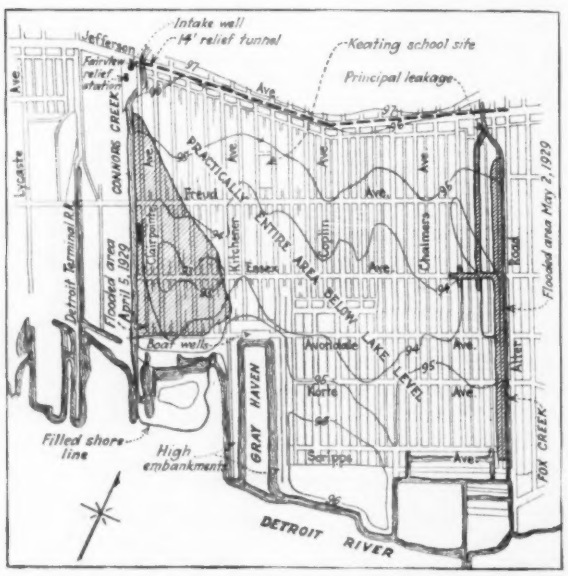


FIG. 1—MAP OF EAST SIDE OF DETROIT, SHOWING FLOODED AREA

Practically the entire area would have been flooded on April 5, 1929, if pumping station had stopped. Shaded areas show portions actually flooded.

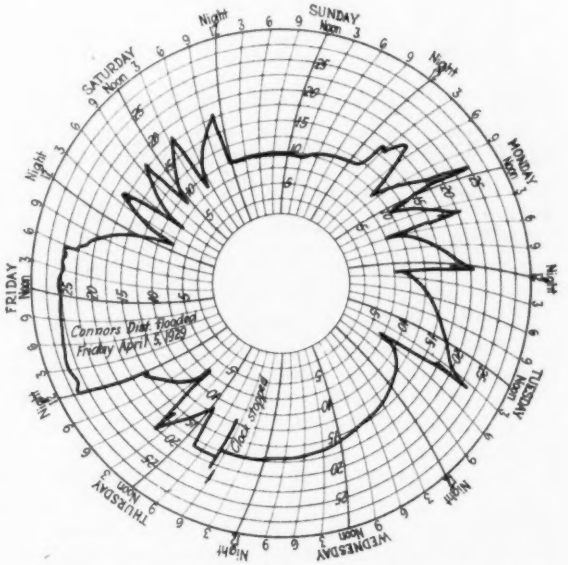


FIG. 2—CHART FROM RECORDING WATER GAGE AT THE INTAKE WELL PUMPING STATION

and contains a population of more than 20,000. It is bounded on the west by Conners Creek, on the east by Fox Creek, on the north by Jefferson Ave. and on the south by the Detroit River. Its surface is for the most part below mean water level and 3 to 4 ft. below the present water level in Lake St. Clair and the Detroit River. It is protected from overflow by dikes, is fairly adequately sewered, is largely paved and is closely built up with moderate-priced modern dwellings over about two-thirds of its area.

Description of Floods

On April 5, 1929, the overtopping of a dike along Conners Creek at the point indicated in Fig. 1 flooded an area of about 85 acres to a depth of between 2 and 3 ft. and damaged more or less about 260 residences and stores, or about one-half of those in the area flooded. A careful survey indicated that the total damage to real property amounted to something more than $23,000.

The overflowing water from the washout in the dike ran rapidly into the sewers and flowed to the Clairepointe pumping stations, where it was discharged into Conners Creek, some of it, no doubt, to return to the flooded area. The operation of the pumping stations, however, over a period of eighteen hours maintained the water in the 14-ft. relief tunnel in Jefferson Ave. at a level sufficiently low to prevent any backing up in the laterals, so that the flooded area was kept within rela-

tively narrow bounds. Had the pumps, which are motor driven, stopped during the period of the break, the damage would have been much more extensive. Practically the entire area shown in Fig. 1 would then have been flooded and water would have backed up into large numbers of basements outside the area to the north and east. Many of these basements are those of business and industrial buildings where valuable materials and equipment would have been damaged.

The story of the water levels is shown in Fig. 2, a reproduction of the recording water gage at the intake well pumping station (*Engineering News-Record*, May 23, 1929, p. 832) recently put into service at the corner of Jefferson and Clairepointe Aves. The break in the

FIG. 3—COMPLETED CLOSURE OF BREAK IN CONNORS CREEK DIKE

dike occurred just before midnight on Thursday, April 4, following or in the midst of a normal spring rain. The water in the pump pit had been rising gradually from 6 p.m. until just before midnight, at which time the chart shows an abrupt rise of about 12 ft. The pumps gained on the water level somewhat from midnight until 6 p.m. of the following day, at which time the break had been repaired. The draining of the area was complete by midnight of April 5, but during April 6 leakage at several points through other dikes protecting the area no doubt accounts for the sawtooth appearance of the record.

It is of interest to record that the gap in the dike about 200 ft. long by 3 to 4 ft. deep was closed by sandbags in about six hours after the forces were organized, a commendable job considering the difficulties involved. The opening was later more permanently closed by sheetpiling backed with earth as illustrated in Fig. 3.

Again on May 2, high water in the Detroit River, coincident with a fairly heavy spring rain, caused flooding in the eastern portion of the area along the west bank of Fox Creek. At 6:50 p.m. the water-works dock gage stood at El. 97.10 city datum, equal to 577.4 U.S.G.S. datum, probably higher than at any time since 1887. The area flooded was much less extensive than on April 5, the damage was nominal and the peak of the rise at the pumping station, although higher, was of shorter duration. The stormwater caused a backing up of Fox Creek, and the principal overflow into the streets was at a bend in the creek just south of Jefferson Ave., although leakage at boat wells and other low points along the creek contributed to the flooding. Fig. 4 shows the creek conditions where the principal overflow occurred.

The April flooding was due almost to entirely to high lake levels, as the rainfall was comparatively small; the May flooding occurred during still higher lake levels and was aggravated by a spring rain. In neither instance, however, was the rain of a magnitude frequently experienced in the summer months. On April 5 the total rainfall was only about 0.4 in., and on May 2 about 1.3 in., spread out rather uniformily over the 24 hours; a record rainstorm in Detroit on July 31, 1925, resulted in a total rainfall in 24 hours of 4.71 in., with a maximum hour of 1.79 in.

History of Area

Although the area involved, originally a marsh, has been subjected in the past to overflow, the recent floods came as a surprise to the inhabitants, who for the most part have bought and built homes during a period of low-water years presumably without knowledge that the pavements in front of their houses were below mean lake level and protected from lake waters by miles of earth dikes on private property.

The story of the development of the area, as revealed from official records, furnishes an interesting commentary on the results that may be expected when real estate operators succeed in carrying through a project over the opposition of a city engineering department. As far back as 1911 R. H. McCormick, then city engineer, refused petitions for sewers on the ground that adequate provision for protection and drainage of the area had not been made, but "the real estate men then went to the Common Council," and, in the words of Mr. McCormick, "we were ordered to proceed with the work." The

FIG. 4—FOX CREEK NEAR POINT OF PRINCIPAL OVERFLOW ON MAY 2, 1929

situation was that an area originally a marsh and through which Fox and Connors creeks flowed without definite outlets had been reclaimed by private owners through dikes and small pumping stations, "by means of which the land was kept dry for farming purposes." The farms were then bought up, subdivided and sold to lot owners, many of whom built homes but were not "aware that the dike and pumps must be maintained to prevent their homes from being flooded."

From the standpoint of engineering it would have been a simple task years ago to protect the area in question permanently from any flooding. The original dikes were sufficiently high to afford the necessary protection but were cut down by property owners. And it was impossible to control this cutting or effect desired permanent improvements, according to an opinion of the corporation counsel in 1912, without an amendment to the city charter permitting the condemnation of private

property for purposes of construction and maintainance of dikes or sea walls. As the area was practically undeveloped at that time and as the danger of any damage of consequence was non-existent, nothing was attempted in the way of charter changes.

Following 1911 there were three years in which Lake St. Clair may have been sufficiently high to have caused flooding in this East Side area—namely, 1913, 1917 and 1919—and some trouble is known to have been experienced. Efforts during this period by George H. Fenkell, then commissioner of public works, to invoke the authority of the public health official in connection with Fox Creek flooding were unsuccessful. Following 1919 the waters of the Great Lakes steadily receded, reaching in 1925-26 the lowest point of record, and then gradually rose to the high water of 1929. The low point in 1926 on Lake St. Clair was El. 90.5, city datum; the highest point this spring was El. 97.2, a difference of 6.7 ft.

Over the decade 1919 to 1929 many dwellings were erected in the area under discussion so that the subdivided portion became rather solidly built up. Along Fox Creek and the canals at the southeast corner the typical development was a dwelling facing the street and on the rear of the lot a garage and a boat house facing the canal, in lieu of the usual alley. Along Fox Creek are a number of instances where the old dike has been leveled off to afford a lawn, the surface of which today would be awash were it not for the temporary sandbag cofferdams placed by the city with the permission of the owners. Extending through the old dike at many points are old boat houses having their wells sometimes concrete lined but frequently only plank lined, not many of which are really watertight structures against any appreciable head. The accompanying Figs. 5 and 6 illustrate some of the conditions as they appear today along Fox Creek and the modern "Venice" that has been developed in the southeast portion of the area.

The Permanent Solution

The permanent solution of this problem involves, first, a consideration of what may reasonably be anticipated as a possible high water on Lake St. Clair. The height for the permanent works should be adequate, but on account of conditions at many points, not any higher than really necessary. The usual liberal leeway adopted as a contingency in many engineering works may not here be allowed.

FIG. 5—TYPICAL CONDITIONS ALONG FOX CREEK; OLD DIKE NEAR DWELLING CUT DOWN

FIG. 6—DWELLING ON CANAL NEAR WEST END OF HARBOR AVE.
High water of March 2, 1929, stood above portions of first floor.

Studies have led to the adoption on the riverfront of El. 100 Detroit city datum and along the adjacent canals of El. 99, corresponding to El. 580.3 and 579.3, respectively, referred to U.S.G.S. datum. These elevations include allowances above monthly means of 3 ft. for wind and wave effect along the riverfront and 2 ft. for piling up in the adjacent canals due to wind action over and above the maximum anticipated monthly mean of El. 577.3. The high water of 1838, often used as a standard, is supposed to have been El. 577.86, and reference to the hydrograph of Lake St. Clair indicates substantially the same elevations reached in 1876 and again in 1883. It may be noted that the adopted maximum anticipated monthly mean is 0.56 ft. less than the high water of 1838, but the minimum wind allowance of 2 ft. for the canals, or the difference between the monthly maximum reading and the monthly mean, is 0.47 greater than any difference discovered in the daily records since 1913. Other factors which were considered but for which no specific allowances were made are the diversion at Chicago, dredging in the Great Lakes channels, deforestation over the Great Lakes drainage and Lake Superior regulation.

Having fixed desirable heights for sea and canal walls, the next problem is to determine how best and with least expense and least public opposition to build the desired walls along miles of canals, similar to those shown in Figs. 4, 5 and 6, where many of the lots are only 30 ft. wide and a large percentage of the owners possess or would desire later to possess motorboat wells through the walls. Inasmuch as Fox Creek, for example, is planned as a large stormwater outlet, the existing channel needs to be enlarged, and a possibly desirable solution for the city as a whole would be to build it into a closed sewer and abandon the boating. The riparian rights of the owners, however, under such a plan would need to be condemned and the cost of the closed outlet, together with the rights and property obtained through condemnation, would no doubt prove excessive. On Connors Creek, which passes through an area mainly developed to industry, boat wells never got a start and the permanent solution has been found in a closed conduit now under construction.

Next the question of financing such an undertaking with equity introduces nice problems. To what extent should the owner of canal property be obligated to pay to protect not only his own home but his neighbor's across the street, and how much should the neighbor, who cares nothing for the canal and has no rights thereon, pay to protect his home? Finally, to what ex-

tent has the public as a whole an obligation to rectify errors of real estate operators who, inadequately controlled by a former city administration, have passed out of the picture?

The high water of 1929, which at one time appeared might exceed all previous records, has not materialized. As recently as May 15, 1929, Gardner S. Williams, consulting engineer, in a letter to the city relative to water levels past and prospective, anticipated that there was a possibility this year of equaling the highest water of record. But hot and dry weather the latter part of May and most of June appear to have had their effect on the peak. The anticipated possible stage for June of El. 97 materialized in only about El. 96.2. The period of rising water which started in 1926 has lasted about the average duration of all rises since 1860, and in magnitude it has exceeded them all; and although one cannot be sure, there is reason to expect that 1930 will not exceed and possibly not equal 1929.

It is of interest to add that an important element in the high spring levels this year was the large discharge released from a controlled Lake Superior, being upward of 1½ times the normal, or reaching a maximum of 110,000 sec.-ft., with the result that the usual low point in the early spring does not appear on the hydrograph.

The temporary works have met the present emergency and can be maintained as such, if necessary, until the permanent solution is found. There are not likely to be therefore any immediate repetitions of recent floods with the resultant charges, such as appeared in the local press in April, that city officials in such instances are neglectful of duty. With attention directed to the situation, the permanent solution, involving answers to the legal, financial and engineering problems, is likely to be found, providing nature, by decreasing its floodwaters, does not relieve man for a time from the pressure of immediate necessity. In the writer's judgment, every reasonable effort has been and is being made by the commissioner of public works, John W. Reid, and the city engineer, Perry A. Fellows, to meet and solve a difficult problem.

The Metal-Clad Dirigible Airship

TEST flights of the first metal-clad dirigible, the "ZMC-2," built by the Detroit Aircraft Corporation for the United States Navy, were successfully completed early in September. Details of the ship's design and construction were given in the Aug. 31 issue of *Aviation* by John T. Nevill. Briefly, the dirigible consists of a metal hull of thin aluminum-alloy sheet in which are inclosed two ballonets of two-ply rubberized fabric, and the control car with two 220-hp., air-cooled engines supported on outriggers. Unlike other airships, the "ZMC-2" carries its lifting gas directly within the hull itself, the ballonets being inflated with air to regulate the gas pressure; in previous dirigibles the ballonets carry the lifting gas. The capacity of the hull is 202,200 cu.ft. The aluminum alloy skin has a gage of 0.0095 in. and is not corrugated. It is so thin the company was compelled to invent a new automatic riveting machine to sew the pieces together.

The dirigible's framework consists of 24 longitudinals of single-rolled channel section and five main transverse circular frames of built-up triangular section, all being stamped out for lightness. Although seven frames of smaller section are spaced between the main transverse members to assist the thin skin in retaining the craft's shape, virtually all of the tensile stress is carried by the five main rings and longitudinals. Two of the rearmost main transverse members are used to support the ship's fins and control surfaces, which are placed 30 ft. forward of the tail. The control car, located amidships, is attached to the central main transverse rings. The fifth main ring is located well forward to take care of stresses on the nose. Forward handling lines are attached to this member. All of the framework is of duralumin, the thickness of the longitudinals varying from 0.014 in. to 0.32 in. All of the fins and control surfaces as well as the control car covering are constructed of corrugated duralumin.

A unique method of construction was used, the hull being built in two upright halves as follows: Metal plating girdling the hull was cut in strips from 6 in. to 17¾ in. wide. Beginning with the end rings at the nose and at the stern, these strips were riveted to the bag piece by piece and the nose or stern, as the case may be, was hoisted toward the hangar roof as the work progressed. For this work an automatic riveting machine of unusual interest was developed. The machine is capable of spacing, inserting and completing 135 rivets per minute. It was set on a carriage, mounted on concentric rails placed directly under each half of the hull. The machine was then adjusted to the proper angle of the hull plating, a gaging device on the machine giving a correct and uniform overlap of the plates. In its operation three strands of wire, size 0.035, were fed like thread into the machine and three rows of rivets are sewed simultaneously.

It is anticipated that all-metal construction in airships of larger size will not increase the weight as compared with fabric construction. Complete, the empty weight of the "ZMC-2" is 8,800 lb.

Fuel for the "Graf Zeppelin"

The fuel problem for the "Graf Zeppelin" in its round-the-world trip was solved in different ways on the several legs of the trip, according to the Linde Air Products Company. Normally, the "Zeppelin" is fueled with Blau gas, a gas produced by cracking oil, which is extremely suitable, as it has about the same specific gravity as air, and a high fuel value. Because it is desirable to keep the buoyancy of such an airship constant, the use of a gas having the same specific gravity as air is desirable, since the load is not then diminished as the fuel is consumed.

Since a supply of Blau gas was not available when the "Zeppelin" left Lakehurst on the first leg of its trip, ethane gas, a gas having about the same weight as air and having a high fuel value, was compressed into steel cylinders and supplied to the "Zeppelin." At Friedrichshafen sufficient Blau gas for the flight to Tokyo was taken on. At Tokyo another change was made. At that point Pyrofax, a fuel gas for use in rural homes, which is manufactured by the Carbide & Carbon Chemical Corporation, was taken on to be mixed with hydrogen, obtained locally for fuel. Pyrofax is not as suitable as ethane, as it is heavier than air, but it had the advantage that it is easily liquefied at comparatively low pressure and so could be shipped from West Virginia to Tokyo in a much smaller number of cylinders than could ethane. For the flight from Los Angeles to Lakehurst Pyrofax gas was again used, this time being shipped from West Virginia in tank cars. At Los Angeles the Pyrofax was mixed with a sufficient volume of natural gas to give it a specific gravity about the same as that of air.

Foreign Track-Recording Device Has Special Features

Novel Method of Measuring and Recording Lateral Movement of Cars Due to Horizontal Irregularities

A NOVEL method of measuring and recording lateral movement of cars due to horizontal irregularities in track is provided in a small track-recording apparatus which has been developed on the Tanganyika Railway, in East Africa, and which is designed also, in somewhat more elaborate form, for heavy main-line track inspection. Fig. 2 shows the recording device to be mounted in the car.

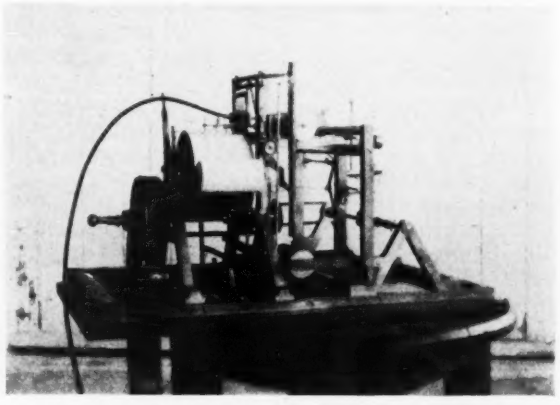


FIG. 2—TRACK-RECORDING DEVICE FOR CARS

In some earlier apparatus of this kind the lateral movements have been recorded by means of a pendulum, the swing being damped by oil or pneumatic cylinders. In the new machine, however, as described by the inventor, the pendulum is replaced by a roller resting in the valley formed by two inclined planes. The roller has its axis parallel with the track and is free to move up one or other of the planes when the car sustains a lateral shock, after which the roller comes to rest quickly. This motion is transmitted to the recording pen and marked on the traveling chart or roll of paper.

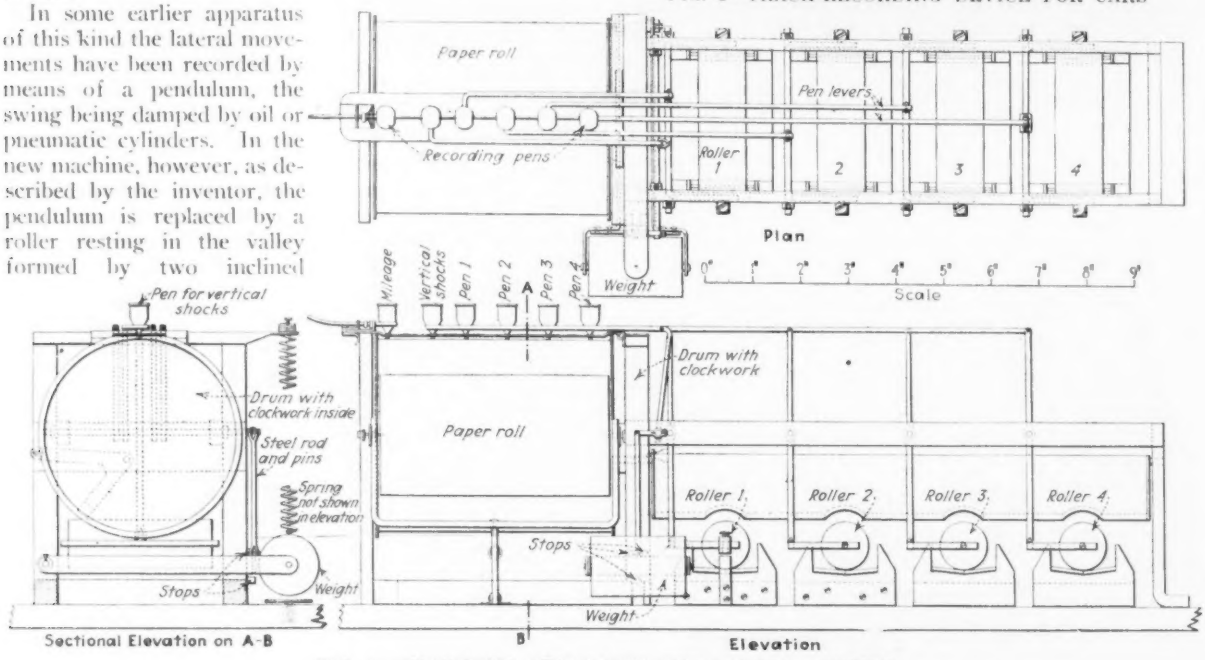


FIG. 1—RECORDING APPARATUS FOR LATERAL SHOCKS

Rollers parallel with the rails ride up inclined planes of different slopes according to intensities of shocks.

The inclination of the planes gives a measure of the intensity of the shock. In the apparatus as shown in Fig. 2, four sets of rollers are provided, set at angles of 5, 8, 11 and 14 deg. with the horizontal. Thus a slight shock will affect and be recorded by the first roller, more severe shocks by the first two or three rollers and the most severe shock by the four rollers.

The machine records only lateral and vertical motion of the car body. The latter measurement is effected by means of a weight suspended from a spring, as in some other similar machines, but in this case the spring draws the weight up against a stop, in order to eliminate the cumulative effect of successive shocks. This machine is the invention of E. Dawson, assistant engineer, Tanganyika Railway, Dar-es-Salam, East Africa. Being small, it is intended for application to passenger cars, rather than for the equipment of a special car. The latter arrangement is commonly used in this country, as in the track-recording car of the Atchison, Topeka & Santa Fe Railway, described in *Engineering News-Record* of Sept. 15, 1927, p. 428. In that car a gyroscope is used to eliminate local vibrations.

New York State Has Large Building Program

A recent report of the Department of Public Works of New York State contains the statement that the division of engineering on July 1 had under its supervision 340 contracts, amounting to more than $41,000,000. Before the end of this year, the report states, "we shall have under way $67,000,000 worth of building construction covered by approximately 600 contracts. This is a larger program for public buildings than is being carried on by the federal government. We are informed that its program for the construction of buildings during the present year will total about $56,000,000."

Welding Society Considers Methods of Testing

Stethoscope, X-Rays and Electric Currents Considered for Non-Destructive Examinations of Welds at Ninth Annual Fall Meeting in Cleveland

Engineering News-Record Staff Report

THE papers of importance to the engineer interested in structural welding that were presented at the ninth annual fall meeting of the American Welding Society in Cleveland, Ohio, Sept. 9-13, centered on the general subject of inspection and testing of welds, particular attention being accorded to non-destructive methods. About 400 members and guests attended the sessions, which were only a part of the National Metal Congress, the other constituent organizations meeting at the same time being the American Society of Mechanical Engineers, the American Society for Steel Treating and the Institute of Metals.

At the National Metal Exposition in the auditorium several hundred exhibits gave a composite picture of today's metal industry. Many new alloys, some domestic and some imported, were especially noticeable. A half-size model of one of the tower window openings in the Chrysler Building in New York, utilizing Krupp Nirostra, a new alloy, was shown. Standard structural shapes rolled from aluminum alloy were exhibited. Welding machines and equipment occupied a prominent position, as did testing apparatus—machines for determining hardness, fatigue and strain.

At a meeting of the fundamental research committee several university professors reported on tests under way to determine fatigue, metallographic structure, strength of welded rail joints, and weld properties by use of strain gages and X-rays. In a report on fatigue tests, Prof. J. H. Thornton, Washington State College, Seattle, stated that of his specimens, furnished by Eastern fabricators, resistance, gas and arc welds stood up under the tests in the order named. The arc welds were found to be imperfect, lacking penetration, and these results were thrown out, particularly after Professor Thornton made some arc weld specimens of his own which compared favorably with the other specimens. Stressed to 12,000 lb., the resistance-welded specimens withstood 100 million cycles in the machine before failure. In discussion at this session, it was the consensus that there should be an open attitude toward telling the whole truth in these fundamental tests and furthermore that care must be taken not to formulate general conclusions from data admittedly meager.

The structural steel welding committee reported on the series of tests it is sponsoring. Forty fabricators throughout the country have made or will make test specimens. Three of the companies are using gas welding, one alternating-current arc welding and the remainder direct-current arc welding. To date, ten companies have completed their tests and five have the work under way. Prosperity in the fabricating industry is blamed for the tardiness of some companies to get their work started; they have been too busy on orders. A total of 1,677 specimens is involved; 597 have been welded and shipped to testing laboratories; 315 are in process of fabrication; and 356 have been tested. Enough tests have been made to start tabulation of results and the secretary was empowered to secure some one to undertake this on a salary basis. One of the important byproducts of the test program, it was felt, would be the education of a large number of structural fabricators in the possibilities of welding.

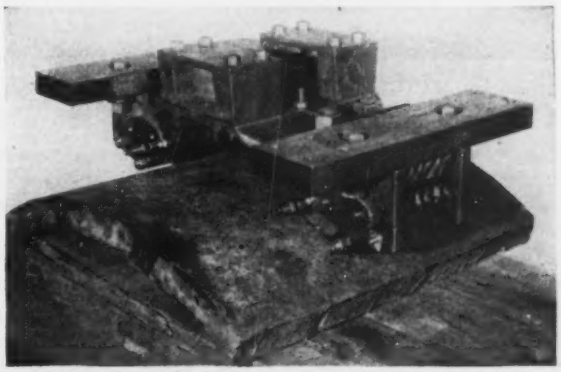
Inspection With Electric Currents

A method of non-destructive internal inspection by electrical means was described in a paper prepared by E. A. Sperry, president, Sperry Development Company. The apparatus he described has been used with considerable success to locate internal transverse fissures in railway track, and according to the author a total of 1,000,000 rails of track has been tested, and work is going forward at the present time at a rate of 20,000 rails per day.

From Mr. Sperry's original studies he discovered that in sound metal an electric current is uniformly distributed, while at an internal flaw the current is interrupted and compelled to pass around the flaw, and that these changes in current could be measured and recorded.

The equipment built for a railway test car, which is identical in principle with that applicable to testing welds, consists of a power plant, radio apparatus and recording devices. The power plant includes a gasoline engine directly connected to a 4,000-amp., two-volt generator, operating at about 900 revolutions per minute. The detecting mechanism is located between two brushes sliding along the rail, and its output is delivered to amplifying apparatus which causes an accurate record to be made of the internal condition of every rail, giving the relative size and location of all internal transverse fissures. In addition to this a spot of white paint is automatically squirted on the rail at the point where the fissure is located. An apparatus of a more sensitive kind was also developed for use in a steel mill manufacturing rails. Other products have also been successfully tested with this device, ranging from standard bridge wire to axles 6½ in. in diameter.

From the above-named applications the method was extended to the inspection of welding to locate pockets, cracks, inclusions, overlaps, etc., and to detect unwelded surfaces which frequently are held in intimate contact under the heavy pressure produced by shrinkage when



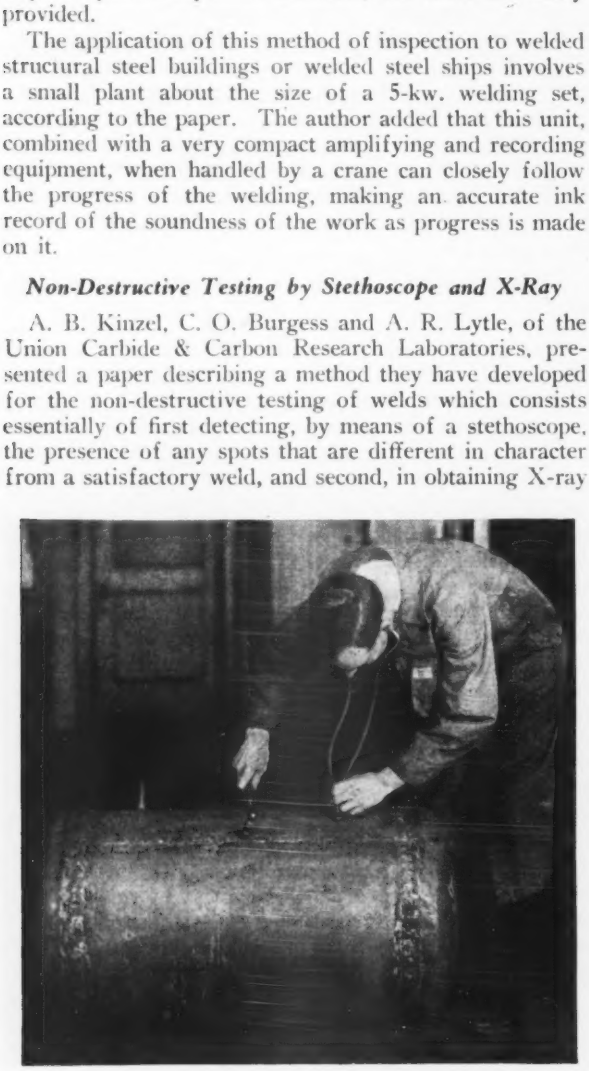
BRUSH RIGGING FOR SPERRY METHOD OF ELECTRICAL INSPECTION

the weld cools. The initial work in testing welds by this electric method was performed on welds joining ¼-in. cold-rolled plates. Both gas and electric welds were inspected, each sample containing a hidden defective spot which was indicated on the record. Also in an examination of a number of butt-welded rods, defective welds were located in spite of the varying cross-section of the welds. In the majority of cases, the results checked with those obtained by destructive tests. Another installation for testing welded joints of plates up to 4 in. thick has also proved satisfactory. Structural shapes require special inspection elements, but these are easily provided.

The application of this method of inspection to welded structural steel buildings or welded steel ships involves a small plant about the size of a 5-kw. welding set, according to the paper. The author added that this unit, combined with a very compact amplifying and recording equipment, when handled by a crane can closely follow the progress of the welding, making an accurate ink record of the soundness of the work as progress is made on it.

Non-Destructive Testing by Stethoscope and X-Ray

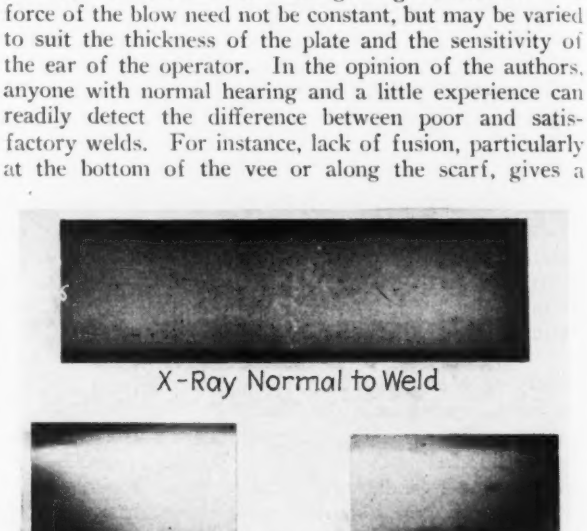
A. B. Kinzel, C. O. Burgess and A. R. Lytle, of the Union Carbide & Carbon Research Laboratories, presented a paper describing a method they have developed for the non-destructive testing of welds which consists essentially of first detecting, by means of a stethoscope, the presence of any spots that are different in character from a satisfactory weld, and second, in obtaining X-ray



INSPECTING WELDS WITH STETHOSCOPE AND HAMMER

photographs of these spots to determine the seriousness of the deviation from the normal. The method is applicable to plates, pressure vessels, pipe and structural steel joints.

The stethoscope is of the ordinary type used by physicians, with a gum rubber tip to exclude extraneous sounds and give contact on the irregular surface as well as to minimize damping of the oscillations at the contact of stethoscope and metal. The stethoscope may be applied on any part of the structure near the point struck (by a hammer), but it is said to be advisable to hold it in one position as long as possible, since this tends to accentuate differences in sound. Usually the hammer is struck directly on the surface of the weld, but striking within 1 in. of the weld on either side gives good results. The force of the blow need not be constant, but may be varied to suit the thickness of the plate and the sensitivity of the ear of the operator. In the opinion of the authors, anyone with normal hearing and a little experience can readily detect the difference between poor and satisfactory welds. For instance, lack of fusion, particularly at the bottom of the vee or along the scarf, gives a



X-RAY PHOTOGRAPHS OF A GOOD DOUBLE-VEE WELD

characteristic reedy, high-pitch, initial note. The sound heard at the instant of first tapping the joint is critical and is a function of the character of the material at the spot struck. Shortly after the tapping, the waves are reflected, and the sound picked up by the stethoscope becomes a composite of the natural vibration of the specimen as a whole and of the forced vibration of the material immediately under the striking hammer. When the defect is very serious, it has a damping effect on the total sound, so that its presence then is also clearly evident in the after ring. Up to the present time the authors have been able to check one another in a most satisfactory manner.

X-ray examination may be used either in conjunction with the stethoscope or independently. Previously X-ray work on welds consisted only in passing the X-rays in a line normal to the plane of the specimen. As a result, some idea of the porosity was noted, but the lack of fusion on the scarf in vee welds was not clearly registered on the film. By taking three photographs, one with the X-rays passing parallel to one scarf, one with the X-rays parallel to the other scarf and one with the X-rays normal to the weld, this difficulty is eliminated. Lack of fusion will thus be noted by a characteristic spot on the developed film.

It was also stated that from the appearance of the film and a knowledge of the plate metal and welding rods used the ultimate strength of the weld may be estimated with considerable accuracy after a little experience.

The necessary time of exposure varies according to the thickness of the plate and the distance between the X-ray tube and the plate, as well as the type of X-ray equipment used. With the 110,000-volt outfit used by the authors, negatives illustrative of the condition of a weld some 6 in. long in 1-in. plate, approximately 2½ ft. from the X-ray target, could be obtained with a 45-minute exposure. This exposure time can be materially

decreased by the use of a 200,000-volt outfit and by arranging the apparatus so that the plate is closer to the X-ray tube. It is best to use the X-ray negative in studying the weld. Positives are seldom plain enough.

Although in most of the welds examined the reinforcement was ground flush to facilitate handling with the particular set-up used, grinding of the reinforcement is not at all necessary, according to the authors, and satisfactory results have been obtained on welds with the reinforcement intact.

The only costs given by the authors are for a semi-portable X-ray apparatus suitable for manufacturing plant work; this would cost between $5,000 and $10,000. However, the authors believe that consulting X-ray service is available at various points throughout the country.

Chemical Reactions of the Carbon Arc

In a report of two series of tests planned to investigate the belief held by some that carbon arc welds in steel members are hard and brittle because the steel absorbs carbon from the electrode, Gilbert E. Doan, assistant professor of physical metallurgy, Lehigh University, and E. Ekholm, of the research department, Aluminum Company of America, stated that with arc lengths greater than $\frac{1}{4}$ in. and with welding currents up to 300 amp. no carbon is absorbed by the weld. Other conclusions were: that the essential action of the carbon arc is one of oxidation of the weld metal and that the permissible arc length is, within limits, independent of the current.

In the first series of tests, made a number of years ago by one of the authors, pure iron and wrought iron with very low carbon content were welded with arcs of varying lengths using a hard-carbon electrode. Welding was done by hand. In the second series of experiments, carried out more recently at Lehigh University, the arc was advanced along the welded member by means of automatic welding heads. The results of both series are shown in the accompanying table.

The fact that rapid oxidation, or burning out of certain constituents, may be observed in the brilliant tail of flame which is thrown out behind the carbon arc during melting, and furthermore the fact that after the arc has passed a heavy powdery deposit of fine red or brownish red oxide covers the weld, indicated to the authors that oxidation of the weld metal instead of carbonization usually takes place on all arcs over a certain minimum of length. In order to verify this hypothesis, a substitution of high-carbon steels (0.38 and 0.58 carbon) was made for the pure iron used in the first experiment. The results of these experiments, also shown in the table, reveal the fact that the carbon is removed in arc lengths as short as $\frac{1}{4}$ in. and almost completely burned out by arcs $\frac{3}{4}$ in. in length.

RESULTS OF TESTS FOR CARBONIZATION OF WELDS

First Series

Current Amp.	Rate of Travel, In. Per Min.	Arc Length, In., Approx.	Weld Member	Position of Carbon Electrode	Carbon Content of Member	Carbon Content of Weld
300	4	$\frac{1}{16}$	Armco Iron	Horizontal	0.02	0.64
300	..	$\frac{1}{16}$	Armco Iron	Horizontal	0.02	0.02
300	4	$\frac{1}{8}$	Armco Iron	Horizontal	0.02	0.02
300	4	$\frac{1}{8}$	Wrought Iron	Vertical	0.01	0.01
300	4	$\frac{1}{4}$	Armco Iron	Horizontal	0.02	0.02
300	4	$\frac{1}{4}$	Armco Iron	Horizontal	0.02	0.02
300	4	$1\frac{1}{4}$	Armco Iron	Horizontal	0.02	
300	4	$\frac{1}{4}$	Wrought Iron	Vertical	0.01	0.015
300	4	$\frac{1}{4}$	Wrought Iron	Vertical	0.01	0.01
			Higher Carbon Steels			
300	4	$\frac{1}{4}$	$\frac{1}{4}$-in. Rods	Vertical	0.05	0.02*
300	4	$\frac{1}{4}$	$\frac{1}{4}$ in. Rods	Vertical	0.38	0.03*
300	4	$\frac{1}{4}$	Rail Steel	Horizontal	0.58	0.47

Lehigh Series

Amps.	Rate of Travel, In. Per Min.	Arc Length	Position of Electrode	Carbon Content of Member	Carbon Content of Weld
220	$5\frac{1}{2}$	$\frac{1}{16}$	Vertical	0.024	0.44
200	$5\frac{1}{2}$	$\frac{1}{8}$	Vertical	0.024	0.05
175	$5\frac{1}{2}$	$\frac{1}{8}$	Vertical	0.024	0.03
220	$5\frac{1}{2}$	$\frac{1}{8}$	Vertical	0.024	0.02
140	$5\frac{1}{2}$	$\frac{1}{8}$	Vertical	0.024	0.02
180	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.024	0.03
220	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.024	0.02
160	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.024	0.02
180	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.024	0.02
			Higher Carbon Steels		
120	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.28	0.05
160	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.28	0.03
180	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.28	0.03
220	$5\frac{1}{2}$	$\frac{1}{4}$	Vertical	0.28	0.02

*Built-up metal, subjected to puddling action by arc.

In the course of the paper the authors reviewed the visible action of the carbon arc, remarking that it closely resembles the crater action in gas welding. "Penetration into the members is the primary action of the carbon electrode process, while deposition of metal upon the members is the primary action of the metallic electrode process," was a conclusion expressed.

In discussion of this paper, disagreements with the results were based on the contention that carbon would not unite with steel under the ordinary conditions of carbon arc welding and therefore that Prof. Doan's conclusions that the length of arc had anything to do with the lack of carbonization were erroneous.

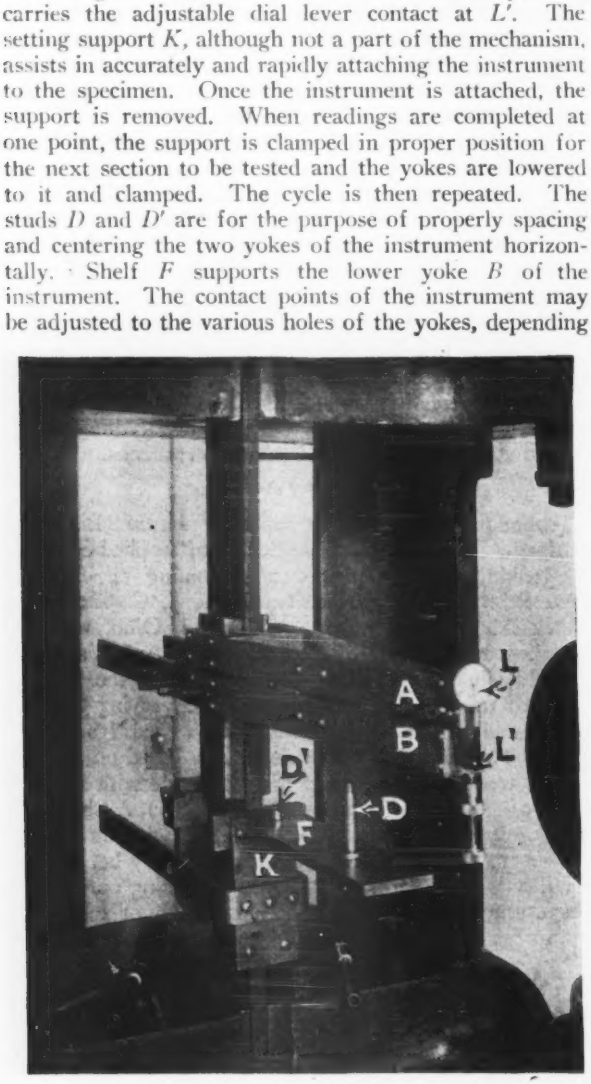
Short and Long Arcs

Although the title of a paper by H. M. Boylston, professor of metallurgy, Case School of Applied Science; A. Jenkin, associate professor of mining engineering, Case School of Applied Science; and J. C. Carpenter, U. S. Aluminum Company, Cleveland, Ohio, was "A Metallographic Study of Some Metallic Arc Welds," a considerable portion of it was devoted to the general effect of using long and short arcs and varying temperatures and amperages. Arc lengths varied from $\frac{1}{8}$ to $\frac{5}{16}$ in. The following conclusions were based on a study of butt welds joining $\frac{3}{8}$-in. plates and made with an electrode of $\frac{5}{32}$-in. bare cold-drawn steel: (1) A short arc appears to produce a stronger weld metal than a long arc, no matter what the arc temperature may be, but the ductility is lower with a short arc when using normal arc temperature and higher when using high or low temperatures; (2) if the allowable tensile working stress is taken as a criterion, there is no difference whether a long or a short arc is used, in the case of normal arc temperature, while the allowable working stress is considerably lower in the case of a long arc with either high or low arc temperature; (3) the combination of high temperature and short arc appears to give the best ductility and the highest allowable working stress; (4) the use of a long arc apparently produces greater porosity in the deposited metal than the use of a short arc; (5) using either normal or high temperature, a long arc produces a coarser grain structure both in weld metal and the adjacent base metal. When using low arc temperature, the long arc has less effect in coarsening.

A New Strain-Measuring Instrument

In the course of a paper reporting a series of tests made to determine stress-strain characteristics of welded joints, J. Hammond Smith, professor of civil engineering, University of Pittsburgh, described a new strain-measuring instrument designed to measure minute longitudinal strains between points in a transverse plane of a joint. The strain-measuring instrument attached to one of the test pieces in the testing machine is shown in one of the accompanying illustrations. The instrument

consists of two yokes, *A* and *B*, which engage the specimen at any desired cross-section by means of eight adjustable, pointed contact screws. These screws and their relation to the cross-section of the welded specimen are shown in the accompanying illustration. The extending arm of the upper yoke *A* carries the strain measuring dial *L*, and the arm of the lower yoke *B* carries the adjustable dial lever contact at *L'*. The setting support *K*, although not a part of the mechanism, assists in accurately and rapidly attaching the instrument to the specimen. Once the instrument is attached, the support is removed. When readings are completed at one point, the support is clamped in proper position for the next section to be tested and the yokes are lowered to it and clamped. The cycle is then repeated. The studs *D* and *D'* are for the purpose of properly spacing and centering the two yokes of the instrument horizontally. Shelf *F* supports the lower yoke *B* of the instrument. The contact points of the instrument may be adjusted to the various holes of the yokes, depending



INSTRUMENT FOR MEASURING STRAIN IN WELDED JOINTS

upon the width of the specimen and the strains to be measured. The dial reads to 0.001 in. and may be estimated to one-tenth of this amount, 0.0001 in. The dial arms are so proportioned that with ½-in. spacing of contact screws a multiplication of movement of approximately 50 is produced. This gives the smallest readings of strain, 0.000002 in. Strain readings are the average readings for the strains of all of the weld beads in the joint, at the particular cross-section being measured. The instrument will take specimens up to 2 in. thick and 10 in. wide.

Francis G. Tatnall, manager, testing equipment division, Southwark Foundry & Machine Company, Philadelphia, reviewed the various methods and equipment for physical testing of welds. According to Mr. Tatnall, there are three main tests to consider: the tensile test, the bend test and the test of the welded structure itself for stress distribution.

Although the tensile test may be made to yield elastic limit, yield point, ultimate strength, elongation and reduction of area, Mr. Tatnall expressed the opinion that nothing is necessary except the ultimate strength of the weld. The bend test, although unusually important, has lacked standardization. Mr. Tatnall recommended that a bend test procedure developed by A. B. Kinzel, of the Union Carbide & Carbon Research Laboratories, be adopted. In this test the cold bend machine is eliminated and the specimen is treated as a small column in free bending, using the compression side of a universal testing machine. The specimen is first slightly bent at the end before being placed in the testing machine and is then bent back upon itself by the machine. Mr. Kinzel has also devised a special bend extensometer which reads the percentage elongation of the outer fiber directly.

For determining stress distribution in welded structures as opposed to test specimens, Mr. Tatnall mentioned the strain gage, the Huggenberger tensometer and the electric telemeter. He also described for job use a portable tensile testing machine of 40,000-ton capacity, also developed by Mr. Kinzel. This machine resembles a small oxygen gas cylinder in shape, size and weight. It is a self-contained unit with built-in pump, and the load readings are taken on a dial.

A new electric recorder used in connection with laboratory testing machines was also described. It is composed of an electric telemeter pressure transmitter installed in the weighing system and connected in circuit with a potentiometer recorder. A wide strip chart advances in proportion to the stretch in the specimen under test, while the moving pen, actuated electrically, makes a continuous record of the load curve.

Pipe Line Welding Costs

In a paper on gas-welded pipe lines, W. R. Ost, of the Air Reduction Sales Company, New York, outlined methods for effecting economies as follows: organizing the labor into gangs, reducing the ratio of helpers to welders, using generators when the cost of acetylene is materially increased by cylinder handling costs; using proper gas pressures; maintaining a low ratio of gas consumed per pound of rod deposited; using large-size welding tips; qualifying the welders; using high-tensile strength welding rods; using jigs and roller blocks; and performing most of the welding operations before trenching.

The following example was given of actual costs of making rolling welds in open country on 10-in. pipe weighing 31.9 lb. per foot:

Labor:

Tacking Gang

Two welders, nine hours at 85c. per hour	$15.30
One helper, nine hours at 50c. per hour	4.50
Eight laborers, nine hours at 50c. per hour	36.00
	$55.80
Cost per joint tacked (based on 80 joints per day), 70c.	

Welding Gang

Four welders, nine hours at 85c. per hour	$30.60
One helper, nine hours at 50c. per hour	4.50
	$35.10
Cost per joint welded (based on 44 joints per day), 80c.	

Material:

Oxygen, 0.34 cu.ft. per joint at $1.25 f.o.b. job	$0.42
Acetylene, 0.31 cu.ft. per joint at $2.60 f.o.b. job	0.81
Welding rod, 1.8 lb. at 10c. lb.	0.18

Overhead:

Depreciation on equipment (based on 600 working days):

Tacking (total equipment $200) (48,000 10-in. joints)	0.004
Welding (total equipment $400) (26,400 10-in. joints)	0.015
Total cost per joint	$2.93

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

More Attractive Engineering Structures

REVIEWED BY C. M. SPOFFORD

Professor of Civil and Sanitary Engineering, Massachusetts Institute of Technology; member of Fay, Spofford & Thorndike, Consulting Engineers, Boston, Mass.

THE IDEALS OF ENGINEERING ARCHITECTURE—By Charles Evan Fowler, M.Am.Soc.C.E., M.Eng.Inst. of Canada, M. Soc. Terminal E. Chicago; Gillette Publishing Co. London: E. & F. N. Spon. Bound; 6x9 in.; pp. 295; index. $4.

Mr. Fowler stands in the forefront of those American engineers who are working to develop in the engineering profession a greater appreciation of the importance of making engineering structures attractive in appearance. Quite recently he gave a practical illustration of the importance he attaches to this by the gift to the American Society of Civil Engineers of the Fowler fund, the income of which is to be used partly for prizes for artistic designs of actually constructed bridges or other engineering works and partly for architectural studies of engineering structures by students. In the book under review is given another illustration of his willingness to devote time and thought to this subject, since the preparation of a book of 300 pages devoted to the setting forth of the fundamentals of artistic engineering design and illustrating these by many examples is a task of no small magnitude.

The aim of the book, in the language of the author, is "to set forth some of those things that ought to be done, and some of those things that ought not be to done, in designing engineering works, to make of them pleasing structures, if not works of engineering architecture, which as a system can result only from long years of education, study and development." In pursuance of this object, the first two chapters of the book deal with general principles and the remaining twelve chapters describe and illustrate actual and contemplated structures, some good and some bad, chiefly bridges, but including towers, lighthouses, power houses and dams. There are also brief biographies of distinguished engineers and a short bibliography. The illustrations, while not comprising all of the notable bridges of the world, are sufficient to cover all the features discussed by the author. Statistical tables are also given covering the general dimensions of a large number of stone and concrete arch bridges, suspension bridges and cantilever and continuous bridges. Unfortunately, these lists do not distinguish between bridges actually constructed and designs never executed, a lack which might prove misleading to students. Some of the bridges listed under stone arches might well be excluded, as they are not of the ordinary voussoir type of stone arch. It is hoped that in a subsequent edition these lists will be revised.

The author's ideas as to what constitutes artistic bridges do not agree in some details with those of certain other writers on the same subject. For example, in the chapter on suspension bridges, the author commends highly the stone towers of the Budapest suspension bridge and comments favorably upon the fact that the cables pass through the towers rather than over their tops.

In the notable "Book of Bridges," by Brangwyn, the distinguished English artist, and Swallow, quite the opposite view of such design is expressed with respect to the Budapest bridge, the Brooklyn bridge and other suspension bridges. One quotation from the "Book of Bridges" is sufficient to show the opinion of these authors:

> The new Manhattan bridge has marvelously long suspension cables which do *not* go *through* a tower or gateway, they actually *pass* over their supports in a logical manner. What a blessing! On the other hand, Brooklyn bridge in New York has the same mistake as our suspension bridge at Clifton; and the pierced towers each with two lancet-shaped openings are affected and trivial.

The reader may take his choice of the above conclusions, but the reviewer agrees with Brangwyn and Swallow, as he is unable to see any logical reason for placing a mass of heavy stonework above the cables at the top of the towers of a suspension bridge. This same feature is noticeable in the design prepared for in closing with masonry the steel towers of the Hudson River bridge, which inclosure the reviewer hopes will never be built.

In conclusion, this book is a noteworthy effort to improve the appearance of engineering works and one which all those intrusted with the design of such works and all students of bridge engineering should read and ponder.

Canadian Concrete Specifications

STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE—Prepared by the Canadian Engineering Standards Association. Paper; 6x9 in.; pp. 149; illustrated. Address the above-named association, 178 Queen St., Ottawa, Ontario, Canada.

The Standard Specifications for Concrete and Reinforced Concrete (A23-1929) has been in preparation since 1921 by a committee of the Canadian Engineering Standards Association, and is now available. The committee was headed by the late Prof. Peter Gillespie and in large measure was guided by the work done by the Joint Committee and by the building regulations prepared by the American Concrete Institute. To meet Canadian conditions, several changes were made. Among them was the use of the Imperial gallon and the Canadian bag of cement, the latter weighing 87.5 lb. gross, rather than that of 94 lb. net as used in the American specifications. Also the Canadian specifications stress the value of the water-cement ratio theory of proportioning somewhat more than did the Joint Committee. On the other hand, the Canadian standards are much less favorable to the slump test than are the specifications of the Joint Committee. For instance, whereas the Joint Committee requires consistency to be measured by the slump test, the Canadian specifications only describe the test as one that is available, and recommend that the trial-mix method is better than the method of specifying set proportions of ingredients with a specified slump in order to attain the desired strength.

The specifications are divided into three parts, the first intended primarily for use of the constructor and the second for the guidance of designers. The third part comprises specifications for materials and methods of

testing, supplemented by drawings, a glossary and a list of algebraic symbols. In Part II the formulas are those generally accepted by conservative designers and arbitrary rulings have been indorsed only when they have a rational basis or have been approved by competent authorities, according to the committee.

Problems in Steel and Timber

REVIEWED BY ROBINS FLEMING

American Bridge Company, New York City

ELEMENTARY STRUCTURAL PROBLEMS IN STEEL AND TIMBER—By C. R. Young, B.A.Sc., C.E., M.Inst. of Can., M.Am.Soc.C.E.; Professor of Structural Engineering in the University of Toronto. New York: John Wiley & Sons, London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 230; 104 line cuts. $3.50.

By reason of its wide and varied collection of problems, this book should be in the library of every instructor of structural engineering. He cannot afford to be without it. As a handy book of reference it will be found valuable to the engineer engaged in practice.

The portion of the book dealing with steel structures fills 177 of a total of 230 pages. Each part takes up tension and compression members, their details, and beams. Part I goes on with box and steel girders, steel roof trusses and cranes, while Part II concludes with timber trestles. An appendix gives answers to the 175 exercise problems at chapter ends.

Practically all of the elementary problems that come within the range of the structural engineer have rules of procedure and methods of applying formulas given for their solution. These are stated in a clear and concise manner, but it is not the province of the book to give the reason for rules nor the derivation of formulas. If one were inclined to be academic, one might question some of the methods followed, to which the author would probably answer as he says of specifications: "The specifications cited are not such as would in all cases be personally recommended by the author, but are given as characteristic specifications in use at the present time."

The chapters on tension members are of special interest. It is noted that 1½ pages are given to welded connections. In the chapter on steel roof trusses a cantilever shelter truss is fully worked out, including stresses due to an *upward* normal wind force of the same magnitude as the downward one. It is refreshing to find a few chapters on timber construction, as there is among engineers a great lack of knowledge on this subject.

The author forestalls much criticism when he writes: "The volume has not been prepared to replace any of the excellent treatises on the theory of structures, but serves as a supplement to them wholly on the problem side." However, the reviewer wishes some subjects had been treated beyond elementary stages. For instance, when the book came to him he was busy with some heavy crane loads to be carried on the high wall columns of a building. He turned at once to Design of a Crane Runway Column (p. 40) but the column illustrated carries only a light crane on a bracket. He also wishes that from the practical standpoint an occasional detail were different. For instance (p. 52) an 18-in. 49-lb. rolled section column is shown fastened to an 18x2 ft. 3 in. by ⅝-in. base plate by 6x6x⅝-in. and 6x4x½-in. angles with eighteen countersunk rivets, when ten rivets, perhaps eight, would have been sufficient. Anchor bolt holes ⅛ in. larger than anchor bolts (p. 47) are not large enough for easy erection of columns.

The problems at the close of most of the chapters are the special feature of the book. The 51 problems on steel beams cover the field of many cases of loading, flexural stress, flange plates, connection angles and roof purlins. The 24 problems on plate girders cover an equally wide range. Problems are noted on the design of column brackets, eccentric loading on columns, combined tension and bending, the splicing of timber tension members, the strength of roof sheathing, all of which are exceedingly practical.

Water-Works of Great Britain and Ireland

THE WATER ENGINEER'S POCKET BOOK AND DIRECTORY, 1929: A Comprehensive Guide to the Water Undertakings of Great Britain and Ireland. London: Water and Water Engineering, 30 Furnival St., Holborn. Flexible; 6x8 in.; pp. 226. 8½ shillings in England.

Brought together here in a "pocketable" volume are handbook data and a water-works directory of England, Wales, Scotland and Ireland. The handbook material includes a brief summary of water acts and supplementary bylaws; tables and formulas; and notes on aqueducts and water distribution, water purification, pumps and pumping. Some of this material is credited to the Manual of Water Works Practice of the American Water Works Association. The "directory" features are an alphabetical index of water and engineers, with the "authorities" (towns and companies) with which they are connected; a listing of water undertakings, with their chief officers, population and area supplied, source of supply, character of water, treatment and proposed improvements. Supplementary to this is a tabulation of water-works statistics, also arranged alphabetically, under England, Wales, etc. This is the first issue of what promises to be a useful annual.

Our Inland Waterways

THE ST. LAWRENCE NAVIGATION AND POWER PROJECT—By Harold G. Moulton, Charles S. Morgan and Adah L. Lee. Washington, D. C.: The Brookings Institution. Cloth; 5½x8 in.; pp. 675. $4.

SHIPWAYS TO THE SEA: Our Inland and Coastal Waterways—By Ernest S. Clowes. Baltimore: The Williams & Wilkins Co. Cloth; 6x9 in.; pp. 196; illustrated. $4.50.

These are two excellent books on the subject of existing and proposed inland waterways of this country, one devoted entirely to the St. Lawrence waterway and the other taking up both the St. Lawrence and the several other inland waterways about which there is current discussion. Both books attempt to set down the pertinent facts concerning these waterways uncolored by personal prejudices and to draw conclusions therefrom which are entirely sound.

The authors of The St. Lawrence Navigation and Power Project take up in great detail all the factors affecting that waterway, its history, the question of what depth is most desirable, costs, what traffic is available, the value of the waterway in traffic congestion relief, its relation to railway rates, and finally the power possibilities. Appendices, making up more than half of the book, give recent correspondence between the United States and Canada on the subject of the proposed shipway, vessels sailing from north Atlantic ports, appraisals of traffic as made by others and a very detailed study of the various classes of traffic which might be handled.

Shipways to the Sea, being a much smaller book and covering a wider range of subjects, does not go into as great detail as does the other work. The author has, however, set down in concise form much valuable in-

formation on the general subject. Although he believes that the future holds great possibilities for waterways in this country, he does not hesitate to say that money spent on some waterways has been thrown away.

On two major and highly controvertial points the authors of the two books reach widely different conclusions. This is the amount of traffic which will move by the St. Lawrence shipway and the saving which will result from the use of that route. Ernest E. Clawes, in Shipways to the Sea, accepts the estimates of the Department of Commerce of a prospective annual traffic of from 18 to 23 million long tons, also the estimate published in Great Lakes to Ocean Waterways that there will be a saving of from 6 to 8 cents a bushel on wheat which "would be passed on to the farmer nearly intact." Neither opinion finds support in the Brookings Institute's book. In the more detailed study of conditions which the authors of the book were able to give the subject many factors were disclosed which tend to reduce greatly the amount of traffic and the saving to the shipper.

Robots and Galley Slaves

MEN AND MACHINES—By Stuart Chase. Illustrated by W. T. Murch. New York: The Macmillan Co. Cloth: 5½x8½ in.; pp. 354; illustrated. $2.50.

Indictments of the machine and its civilization are not uncommon, nor do we lack for defenders of the modern system. Mr. Chase, however, adopts the attitude of neither faction. In his own words, he is a "statistical Don Quixote" in search of facts upon which to base an honest comparison between the present and the past. Writing in a straightforward, entertaining and dispassionate style, he assembles and examines closely available data bearing on the machine and its influence on human beings, and then, in a few final chapters as absorbing as the climax of a good detective story, presents his conclusions. Although not entirely favorable to the power age, these final conclusions are, on the whole, optimistic. If we have not yet attained Utopia, we are at least on a road which may lead to that happy land. The way, however, is not without its obstacles, the most dangerous of which, in Mr. Chase's opinion, are three in number: mechanical warfare, depletion of natural resources and what he terms "technological tenuousness." The latter refers to the increasing dependence placed by man for the necessities of life upon complicated systems (public utilities are examples of these) controlled and thoroughly understood by a very small proportion of the population. The average citizen, in an emergency, would be helpless in the realization that faucets do not produce water, nor delicatessen stores food. As an example of this danger on a large scale, Mr. Chase refers to conditions at Detroit during the period in which the Ford plants ceased production, putting 60,000 men out of employment for a year, with far-reaching effects upon banks, retail stores and, to some extent, the prosperity of the entire city.

Men and Machines is an outstanding example of the new type of literature which presents to the layman such subjects as psychology, history and other sciences formerly limited to the student and the specialist, and does it in a way not only understandable but also intensely interesting. Those engineers who resent the charge that they are narrowminded and too closely bound to the slide rule and drawing board will find this book both thought-provoking and absorbing. They may not agree with the author's conclusions, and almost certainly they will be irritated by his insistence at terming a structural steel worker as "steel bird," but they cannot fail to get an inspiring idea of the benefits and defects of the civilization in which they play so important a part.

The illustrations, by W. T. Murch, are in the modernistic manner quite in keeping with the context of the volume, and add appreciably to it. Frequent quotations are used, some of which are duly credited to their originators; it is regrettable that there are many which are "orphaned." Those to whom the subject is provocative of further reading will find a bibliography included.

Roadside Planting and Utilities

ROADSIDE DEVELOPMENT—By J. M. Bennett, Superintendent of Parks and Forestry, Board of County Road Commissioners, Wayne County, Mich. Land Economics Series, Edited by Richard T. Ely, Ph.D., LL.D., Director of the Institute for Research in Land Economics and Public Utilities, and Research Professor of Economics in Northwestern University. New York: The Macmillan Co. Cloth: 5½x8 in., pp. 268; many halftones and line cuts. $5.

Keeping close to the thesis that it is roadside development and not roadside beautification that concerns the public roads official, this book—the first, we believe, on its subject—deserves attention. The work being new in highway practice, the author necessarily has gone outside of highway experience for his information. Landscaping, tree planting, tree surgery, tree pruning and tree trimming information is, for example, largely culled from standing landscaping practice. In general the author has shown reticence and judgment in not carrying the landscaping viewpoint beyond its proper and secondary place in roadside improvement. He gives more limited space to roadside developments for convenience and safeguarding traffic, but in these practices he had far less experience to draw from. For his account of comfort stations, parking spaces, camping grounds, water supply and disposal of wastes he draws largely on Wayne County, Michigan, practice. In later editions the survey should be carried farther: there are more important roadside developments than landscaping or park development. A useful feature of the book is a digest of laws governing roadside development.

A Contractor Writes on Banking

EPOCHS IN AMERICAN BANKING—By Noble Foster Hoggson. New York: John Day Company. Bound: 6x9 in.; pp. 250 plus index: 27 illustrations.

Among the subjects treated in this readable and handsomely made illustrated book by the head of a well-known building construction organization are wampum and other token money, our first mint and our first bank, the birth of our currency, the father of our banking system (Alexander Hamilton), the use of trust companies and finally, the Federal Reserve System.

How to Make Reports Effective

REPORT WRITING—By Carl G. Gaum, M.E., M.A.S.M.E., Professor of Engineering Extension, the Pennsylvania State College and Harold F. Graves, M.A., Assistant Professor of English Composition, the Pennsylvania State College. New York: Prentice-Hall, Inc Cloth; 6x9 in.; pp. 319; illustrated. $5.

In the Preface the authors state: "Nowadays reports play a large part in public and corporate affairs. As a natural consequence, an increasing number of men and women must know how to write them. When no standardized form is furnished, it is often difficult to develop a logical arrangement for a report and to present clearly and emphatically the facts and ideas which it must

contain. This book, which applies certain principles of composition and rhetoric to the special field of the report, is intended to be helpful to those writers who are either inexperienced or less effective than they would like to be."

With this object in mind, the authors take up different varieties of reports and endeavor to point the way to the best style of composition for each. Examples from actual experience are given, and there are some specimens that show a style of composition to be avoided.

The volume is intended to be a textbook, and if the engineering student absorbs and puts into practice the principles taught therein, he will undoubtedly be better prepared to succeed when he goes out of college to practice his profession.

Publications Received

A HISTORY OF THE INDIAN RAILWAYS, issued by the Railway Board, Government of India, Simla, India (9 shillings), is composed of summaries of the development, construction features and financial details of the several individual railways, government and private. But there is no history of the railway system of India as a whole, nor are there any combined statistics for the railway system. Besides a good general map there are diagrammatic maps of the most important lines.

X-RAYS IN INDUSTRY is the title of a 60-p. illustrated booklet issued by the Eastman Kodak Company, Rochester, N. Y. The use of X-rays for inspection purposes is increasing rapidly, as radiography offers a means of internal examination without injury to the material. Steel and aluminum castings, welds, trees and telephone poles and a variety of other objects have been successfully examined by this method. The booklet states briefly how X-rays are produced, describes the necessary apparatus and presents rules for the proper exposure and manipulation of radiographic film.

A MANUSCRIPT CIRCULAR entitled "An Engineer's Library of Seismology," by Prof. Ernest A. Hodgson, of the Dominion Observatory, Ottawa, will prove of considerable reference value to many who are concerned with the possible danger of earthquake effects. This circular not only gives a brief book list of the best available publications, but it also presents an analyzed reference list under separate headings, such as "Depth of Earthquake Foci," "Insurance and Earthquakes" and the like, with references to the complete reference list of more than 1,000 entries which has been currently published by the Seismological Society of America and its Eastern Section, and is now being continued by the Dominion Observatory.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ADMINISTRATION REPORT, Madras Public Works Department—Part II—Irrigation. Paper; 6x10 in.; pp. 450; illustrations, folding maps and tables. 5 rupees from bookdealers in India or from High Commissioner for India, 42 Grosvenor Gardens, London, S. W. 1, India.

AERIAL NAVIGATION AND METEOROLOGY—By Capt. Lewis A. Yancey, Master Mariner; second revised and enlarged edition. Cloth; 6x9 in.; pp. 316; illustrated. $4.

The author was navigator of the plane which recently flew from Old Orchard, Me., to Rome, Italy. According to the publisher's announcement, the book was written to "help the average man and give him a good working knowledge of the elements of navigation and meteorology and does not call for a technical education on the part of the reader."

ANALES DEL PRIMER Congreso de Irragaction y Colonizacion del Norte. In four volumes. Lambayeque, Peru: Sr. Secretario General, Congreso de Irragaction y Colonizacion del Norte. Paper; 6½x9½ in.; pp. 1273 in the four volumes; illustrations and folding plates.

BLUEPRINT READING FOR THE MACHINE SHOP AND RELATED TRADES—By Joseph Brahdy, B.S., C.E., Brooklyn Vocational School, Brooklyn Evening Technical and Trade School. Second edition. New York and London; McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 199; 134 illustrations. $2.

A revised edition, in a new form, of a book first published a half-dozen years ago. Intended for both school and industrial use.

BUILDING CONSTRUCTION: Types of Construction, Materials and Cost Estimating—By Whitney Clark Huntington, C.E., M.A.S.C.E., Professor of Civil Engineering, University of Illinois. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 6x9 in.; pp. 596; line cuts and halftones. $6 net.

THE DETERIORATION OF STRUCTURES IN SEA WATER—Ninth (Interim) Report of the Commitee of the Institution of Civil Engineers—Edited by John Purser, M.Sc., B.A.I., Assoc. M.Inst.C.E., Secretary to the Committee, and H. J. Grose, M.C., B.Sc. London: His Majesty's Stationery Office. Paper; 6x10 in.; pp. 69; illustrations and tables. 3s. 6d.

Deals with wrought iron and with steel, nickel steel, etc., and cast-iron test samples.

DIE DEUTSCHEN EISENBETONBESTIMMUNGEN VON 1925 zum bequemen Bebrauch für die Entwurfsbearbeitung nach Konstruktionsgliedern geordnet und ausgelegt—Von Dr.-Ing. Ernest Rausch, Privatdozent an der Technische Hochschule, Berlin. Berlin: Julius Springer. Paper; 5½x8 in.; pp. 86; 64 linecuts. 4.80 rm.

DIE EMSCHER-KLARANLAGE BEI ESSEN-KARNAP—Von Dr.-Ing. M. Prüss, Vorstand des Abwasseramtes der Emschergenossenschaft in Essen. Reprinted from "Gesundheits Ingenieur, 1929." Address the author, Essen, Germany. Paper; 6x8 in.; pp. 52; 41 illustrations.

FINANCIAL SETTLEMENTS OF DEFAULTING IRRIGATION ENTERPRISES—By Wells A. Hutchins, Associate Irrigation Economist, Division of Agricultural Engineering, Bureau of Public Roads. United States Department of Agriculture Circular No. 72. Paper; 6x9 in.; pp. 46. 10c. from Superintendent of Documents, Washington, D. C.

GROUNDWATER IN YELLOWSTONE AND TREASURE COUNTIES, MONTANA—By George M. Hall and C. S. Howard. Prepared in co-operation with the State Engineer, the Department of Chemistry of the Montana State College, Bozeman; and the Water Laboratory of the Montana State Board of Health. Water Supply Paper 599. Paper; 6x9 in.; pp. 118; illustrations and tables. 25c. from Superintendent of Documents, Washington, D. C.

HANDBOOK OF BUILDING CONSTRUCTION: Data for Architects, Designing and Constructing Engineers and Contractors. Vols. I and II—Compiled by a staff of fifty specialists. Editors-in-Chief, George A. Hool, S.B., Consulting Engineer, Madison, Wis., Professor of Structural Engineering, the University of Wisconsin, and Nathan C. Johnson, M.M.E., Consulting Engineer, New York City. New York: McGraw-Hill Book Co. Second Edition. Bound; 6x9 in.; pp. 1611 in both volumes; many illustrations. $10.

HANDBOOK OF FORMULAS AND TABLES FOR ENGINEERS—By Clarence A. Peirce, Formerly Assistant Professor of Power Engineering, Cornell University; Walter B. Carver, Professor of Mathematics, Cornell University, and Charles E. O'Rourke, Assistant Professor of Structural Engineering, Cornell University. Third Edition. New York and London: McGraw-Hill Book Co. Bound; 5x7 in.; pp. 228; line cuts. $2.50.

Additions of "some of the more essential civil engineering data," particularly "tables of weight pressure formulas, loads and stresses in various types of engineering construction," are a feature of this edition. The section on mechanics has been rewritten and divided into "statics, dynamics and hydraulics" and structural formulas. The mathematical sections remain as before.

AN INTRODUCTION TO MECHANICS—By J. W. Campbell, Ph.D., Professor of Mathematics, University of Alberta. New York: Houghton, Mifflin Co. Cambridge, Mass.: The Riverside Press. Cloth; 5x8 in.; pp. 384; 154 line cuts. $3.50.

KOSTENBERECHNUNG IM INGENIEURBAU—Von. Dr.-Ing. Hugo Ritter. Zweite umgearbeitete und erweiterte Auflage. Berlin: Julius Springer. Paper; 6½x9½ in.; pp. 147. 7.50 rm.

NUMERICAL TABLES of Hyperbolic and Other Functions—By J. W. Campbell, Ph.D., Professor of Mathematics, University of Alberta. New York: Houghton, Mifflin Co. Cambridge, Mass.: The Riverside Press. Cloth; 5x8 in.; pp. 76. $1.25.

THE OXYACETYLENE WELDER'S HANDBOOK: A Complete and Practical Manual of Modern Practice—By M. S. Hendricks, Editor, *The Acetylene Journal*. Chicago: The Acetylene Journal Publishing Co. Flexible; 4½x6¼ in.; pp. 208; illustrated. $3.

POPULAR RESEARCH NARRATIVES—Vol. III—Fifty brief stories of research invention or discovery directly from the "men who did it." Collected by the Engineering Foundation. New York City. Baltimore: The Williams & Wilkins Co. Cloth; 5x7½ in.; pp. 174; photographs. $1.

A wide range of engineering and other technical subjects is covered in a space less than four pages for each.

PROCEEDINGS OF SEVENTH ANNUAL WATER WORKS SCHOOL, Kansas—Edited by James L. Barron, Assistant Professor of Sanitary Engineering, University of Kansas, and Assistant Engineer, State Board of Health. Lawrence: Kansas Water Works Association. Paper; 6x9 in.; pp. 136; illustrations.

PROPERTIES AND MANUFACTURE OF CONCRETE BUILDING UNITS—Circular No. 304 of the Bureau of Standards; George K. Burgess, Director. Washington, D. C.: Bureau of Standards. Paper; 7x10 in.; pp. 49; halftones.

REPORT OF THE BRIDGE STRESS COMMITTEE: Department of Scientific and Industrial research. London: His Majesty's Stationery Office. New York: British Library of Information, 5 East 45th St. ($4.80, plus local postage.) Boards, cloth back; 8½x13¼ in.; pp. 215; plates, illustrations in text and folding tables. 18 shillings net.

REPORT OF THE NATIONAL COMMITTE on Calendar Simplification for the United States submitted to the Secretary of State. Rochester, N. Y.: Office of the Chairman, 343 State St. Paper; 6x9 in.; pp. 119; line cuts.

STANDARD PLUMBING CODE: Sections of New York State Statutes Relating to Plumbing, Together With Standard Plumbing Code Recommeded by the State Department of Health for Municipalities of New York State. Albany: Commissioner of Health. Paper; 6x9 in.; pp. 52; line cuts.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Plea for Deeper Channel for the Mississippi River

Sir—I am at a loss to understand why the navigation channel of the Mississippi River, according to the plan adopted, should be limited to a depth of 9 ft. The army engineers were at first opposed to spending anything for improving the navigation of the river. The navigable channel of the Ohio and Monongahela rivers is 9 ft. in depth, and I suppose those responsible for the plan for improving the Mississippi felt somewhat ashamed of a plan that would stop barges coming from Morgantown, W. Va., when they reached the Father of Waters. Every foot of increase in the depth of the navigable channel will lessen the pressure on the levees.

The New York State Barge Canal accommodates barges drawing 12 ft. of water. These barges can now reach Chicago, and with the completion of the Chicago Drainage Canal they can reach the Mississippi River. It would seem that a depth of 12 ft. would be a logical plan for the improved channel of the Mississippi.

This is an era of deep river waterways. The Amazon is navigable for oceangoing vessels from its mouth to Quitos, in eastern Peru. The River Plate is navigable for oceangoing vessels as far as Corrientes, in Argentina. The Paraguay River accommodates vessels drawing 12 ft. of water as fas as Asuncion, the capital of Paraguay. Portland, Ore., has a river harbor 40 ft. in depth. Philadelphia is clamoring for a 40-ft. channel to the Atlantic.

Why not have a little vision and look forward instead of backward?

W. A. WARREN.

Hazakstan, U.S.S.R.,
Alma-At, Komomolsky No. 10.

Is the Water-Cement Ratio the Last Word?

Sir—Of recent months several communications have appeared in the columns of *Engineering News-Record* about concrete. All have been interesting public records of the reactions of various men to the many industrial and technical problems found each day in the practice of the art.

The constant reviving of these controversial subjects is not due to a perversity of mind among professional men. Discussion, question and crossquestion are prompted rather by a general realization of how inadequate is our present knowledge about concrete, by determination to learn more, and, through real learning, to profit more than we are able to profit at the present time.

Naturally enough, these published discussions have either centered around or brought in to greater or less degree the water-cement ratio theorem. Owing to able propaganda based upon this doctrine, it has been impossible of recent years to raise any question about concrete that is not referred in almost absolute degree to the water-cement ratio for answer. But inasmuch as the water-cement ratio applies only to the achievement of strength and as concrete never fails or misbehaves from lack of sufficient strength to meet applied physical stress, it would seem either that engineering and research brains have plodded in a treadmill circle through lack of desire to get somewhere or else that they have failed, in studying strength exclusively, to realize that strength in abundance is the one property of concrete we may almost take for granted and almost regardless of obedience or disobedience to doctrinal rules and regulations.

In the writer's belief, it is both unfortunate and shortsighted to attempt to explain all influences, all behaviors, all accidents, all climatic exaggerations and all else on one single phenomenon—that is, the phenomenon of strength as found in a condition-controlled laboratory—and to the neglect of all else. The writer further believes that it is unhealthful and economically suicidal to utter as of the inspired philosophy of the industry any narrow or incomplete or incorrect statement or reasoning in order to prove the doctrine right, rather than impartially to examine behaviors-in-fact as they exist in commercial constructions as well as their attendant circumstances of production and conditions of service.

The problem of concrete is not circumscribed by the question of being for or against the water-cement ratio, as seems to be the burden of the recent letter of F. R. McMillan vs. G. M. Williams. By virtue of its nature and origin, the water-cement ratio is and probably always will remain a point—and a very tiny technical point—on a vast horizon. Unquestionably, diluting glue with water means mucilage; and unquestionably using mucilage to stick things together means less strength than when glue is used.

Thus far, but apparently no farther, the water-cement ratio is fairly true in both laboratory and in field. But the hammering home of this fact by the protagonists of the water-cement ratio has done much good, for it has made all cement users realize that too much water is bad for concrete. But while this evil is supposed to be incurred in reduction of strength, it is none the less well to recognize that fully as much evil results from separation and lack of uniformity in the mix because of the wash-out action of too much water as from any reduction of strength.

If we were permitted to design with higher stresses, with smaller sections, strength and its regulation would be a vital thing. But even were such usages permitted and at hand, there yet remains a host of problems pertaining to concrete wherein the water-cement ratio offers no solution and no clue.

Significant of this, Walter H. Wheeler in a recent communication has written the following, in such finely chosen words as to merit repetition in full:

> Long experience makes one hesitate to accept unreservedly the claims that are made for the water-cement ratio as more or less of a cure-all for concrete troubles. Accurate control of the quantity of water in the concrete mix is unquestionably very important, but there are so many other factors which vitally affect the strength and durability of concrete that it seems unfortunate that the water-cement ratio has been allowed to occupy the spot-light position alone and so continuously.

Mr. Wheeler is right in this summarizing of an industrial situation, although his listing of needs is too brief. And he is right in more senses than one, for the commercial usage of the water-cement doctrinism holds that if we specify according to this doctrine, then the concrete, *however made in actuality*, approaches perfection.

This is daily being proved untrue. And perhaps as a reflex consequence, the feeling seems to be growing that, prescription in hand, the laborer should be exalted above the trained engineer; and that both inspection and living up to the specifications are not only unnecessary but many degrees beyond a nuisance as well.

Realizing these things, it seems regrettable that the many disabilities that afflict concrete should not be removed by thought and study broader than researching and re-researching on strength tests and water-cement ratio alone. Those ploddings and reploddings will never get us anywhere by themselves. And in the meantime concrete must compete with other structural materials as never before in its history.

This letter is comment, not a treatise on concrete or construction in concrete. To the writer's mind, the problem of progress is not difficult, nor is the solution of those technical problems that arise every day in the utilization of concrete.

In the writer's belief also, these problems will never be solved by re-threshing old straw. The history of experience shows that some individual with a vital need and with sound physical, chemical and economic training to guide and to short-cut his searchings will, in all probability, evolve by thought, by experimentation and by final commercial application such means and methods as are most needed toward substantial improvement.

If *Engineering News-Record* were to provide through its columns a forum for making public record of work of this character already done by individuals, it would measurably benefit the art.

NATHAN C. JOHNSON.

New York, N. Y.,
Sept. 5, 1929.

News of the Week

Gen. Lytle Brown Is Named by President Chief of Engineers

Work of Corps Will Be Decentralized, It Is Announced by the Administration

PRESIDENT HOOVER on Sept. 17 sent to the Senate the nomination of Brig.-Gen. Lytle Brown to be Chief of Engineers with the rank of major-general for a term of four years to succeed Lieut.-Gen. Edgar Jadwin.

In announcing the appointment, President Hoover stated that important alterations will be made in the Corps in order to decentralize the work. Because of the great responsibilities brought about by the Mississippi flood-control program and the contemplated waterways from the Great Lakes to the sea, the President feels that Engineer officers directly responsible to the Chief should be on the location to supervise these works.

It is the administration's intention to have three engineers appointed to take entire charge of this work and to be located in the field. One of these engineers would supervise the flood-control work in the lower Mississippi, another would have charge of the work on the tributary streams, while the third would be located in one of the Great Lakes cities and would have under his direction the carrying out of the waterway projects connecting these bodies of water with the sea.

Any of the more important civil engineering projects now before the War Department constitutes a larger problem than did the Panama Canal, it was pointed out at the White House. For this reason it is believed particularly desirable to make provision for greater control of the work in the field and to cut down centralization in Washington.

The President had no announcement to make concerning the new assistant Chief of Engineers.

General Brown was born at Nashville, Tenn., Nov. 22, 1872. He was appointed from that city to the U. S. Military Academy in 1894. Upon graduation from West Point in 1898 he was commissioned a second lieutenant in the Corps of Engineers. He served at Willets Point, N. Y., until the outbreak of the Spanish-American War, when he was ordered to Cuba, where he participated with Engineer troops in the Santiago de Cuba campaign, including the battle of San Juan Hill and the siege of the city.

In 1912, having attained the grade of major, he took command of the 2d Battalion of Engineers and served at Fort Leavenworth, Kan., at San Antonio and Texas City, Tex., and with the punitive expedition into Mexico. From 1916 until the entrance of the United States into the World War he was in charge of the U. S. Engineer districts at Nashville and Chattanooga, Tenn. He was an instructor at the first officers' training camp at Fort McPherson, Ga., from May to August, 1917, and having attained the temporary rank of Colonel in the latter month, he assumed command of the 106th Engineers at Camp Wheeler, Ga., where he served until March, 1918. He was appointed a temporary brigadier-general in April, 1918, and soon thereafter was detailed as chief of the war plans division of the General Staff, in which capacity he served at Washington, D. C., throughout the World War until June, 1919. After a year's service in command of the Engineer regiment of the Second Division at Fort Sam Houston, Tex., he was ordered in 1926 to Washington, D. C., as assistant commandant at the Army War College. He was promoted to brigadier-general on June 27, 1928. He at present is in command of Fort Davis, Canal Zone. General Brown has received the following decorations: Order of the Bath (British), Legion of Honor (French), and the Distinguished Service Medal (United States).

General Brown's recent service has been outside the Corps of Engineers. His former standing in the Corps would have placed him tenth on the list of colonels. He has seven years of active service before he becomes due for retirement, sufficient time for the major part of the Mississippi River flood-control work to be carried out under his direction.

Motor Speedway Proposed Over Electrified Railway Tracks

Plans have been announced for the electrification of the Grand Trunk lines between Detroit and Pontiac, Mich. They involve the erection in Jefferson Ave., Detroit, of a modern terminal station and office building and the construction over the electrified railway lines of a motor speedway from Jefferson Ave. to Pontiac. The ultimate cost of terminal and speedway is $100,000,000, of which an immediate outlay of $25,000,000 is proposed.

The motor speedway will be constructed on the columns carrying the overhead wires of the electrified system. The roadway will be not less than 40 ft. wide and will be surfaced with asphalt. It will provide for four streams of traffic, the inner lane in each direction being for high speed, while slower moving traffic will be confined to the outer lanes.

Ramps will be provided by means of which slower traffic may enter and leave the speedway at important intersections.

17-Line Railroad Merger Proposed in Eastern States

Loree Seeks Consolidated System Totaling 13,553 Miles—New England Lines Included

PLANS for an amalgamation of seventeen Eastern railroads into a comprehensive system to serve the Atlantic seaboard from Maine to Virginia are included in an application filed Sept. 17 with the Interstate Commerce Commission by L. F. Loree, president of the Delaware & Hudson Railroad. This would include 13,553 miles of line with a total investment, as of Dec. 31, 1928, of $2,700,000,000.

Lines included in the suggested plan are as follows: Delaware & Hudson; Bangor & Aroostook; Buffalo & Susquehanna; Buffalo, Rochester & Pittsburgh; Central Railroad of New Jersey; Delaware, Lackawanna & Western; Lehigh & Hudson River; Lehigh & New England; Maine Central; New York, New Haven & Hartford; New York, Ontario & Western; Pittsburgh & West Virginia; Reading; Rutland; Virginian; and Western Maryland. Trackage rights are requested along the line of the New York Central on the west bank of the Hudson River from Albany to the New York, Ontario & Western's line near Cornwall, N. Y.

In outlining the purposes of the system, the application states:

> The proposed system would be a belt, or terminal system, for the whole north Atlantic seaboard. Reaching every port, from the Canadian boundary to and including Hampton Roads, it would be able to carry traffic of each and any of its connections now existing or hereafter created to any of these ports. It would afford all carriers not reaching one or more of these ports the opportunity to accept traffic therefor, and could and would carry such traffic on equal terms and without favor to one connection as against any other connection.

Territory covered by the railroads involved in the plan includes thirteen states and the District of Columbia, with a population aggregating 33.5 per cent of that of the entire United States. Lines extend southward from Canada along both sides of the Appalachian Mountains. A prominent part in the plan is given the hitherto neglected New England district.

As noted elsewhere, the Interstate Commerce Commission has now under consideration a comprehensive plan of its own for railway integration, details of which have not been made public. In addition, a number of other consolidation plans have been presented to it, all of which are being held in abeyance pending the approval of a definite program allocating all railroads in the East.

Kansas City Water-Works Is Exempt From Assessment

That a drainage district in Kansas cannot collect a special assessment levied against water-works properties located in Kansas belonging to Kansas City, Mo., is stated in a decision of the Circuit Court of Appeals for the Tenth Circuit recently handed down. This reverses a decision of the District Court of Kansas noted in *Engineering News-Record*, Aug. 23, 1928, p. 294. Suit was entered by the Fairfax Drainage District of Wyandotte County, Kan., a body created by the State of Kansas to protect from overflow certain properties within which is located the water-works of Kansas City, Mo. Drainage expenses were assessed by the district in proportion to benefits received, but Kansas City refused to pay its assessment on the ground that it was exempted from the levy by an interstate treaty providing that neither the State of Kansas nor any county, township or municipality located within such state should collect any taxes, assessments or imposts of any kind or character whatsoever on the portion of the water-works plant of Kansas City, Mo., located within the State of Kansas.

While the lower courts had held that this compact between the states did not prevent the assessment of special benefits against the property, the opposite view was taken by the Circuit Court of Appeals.

Power Companies in New York State Consolidate

The Niagara-Hudson Power Corporation, organized this year by J. P. Morgan & Company interests, has taken over control of the Frontier Corporation and the St. Lawrence Securities Company. The Frontier Corporation owns most of the land required for the development of power at the Long Sault on the St. Lawrence River, and the St. Lawrence Securities Company controls numerous hydro-electric power plants and power sites on the St. Lawrence slope of the Adirondack Mountains. This transfer of these properties to the control of the Niagara-Hudson Power Corporation therefore brings under its control a large part of the hydro-electric power in the State of New York.

Illinois Central Accepts Plan for New Orleans Station

The Illinois Central Railroad Company has accepted the revised plan for its new passenger station at New Orleans which was prepared by the Louisiana Public Service Commission, and it is expected that the commission will issue an order immediately granting its approval of the construction of the station.

The cost of the work is estimated at $4,000,000.

Propose New Subway System in New York Totaling 100 Miles

295 Track-Miles of New Line Would Include Two River Tunnels—Estimated Cost $438,400,000

NEW lines totaling 100.12 miles and containing 295 miles of track will comprise the second step of the New York municipal subway system, according to a statement issued Sept. 15 by the Board of Transportation. The new system, estimated to cost $438,400,000, will reach from the southern tip of Manhattan northward to the far extremes of the Bronx, and, with two new crossings under East River, will extend across Brooklyn to branch out into several lines serving wide areas in Queens, including the Rockaway Beaches. A line will also run down Stuyvesant and Utica Aves. in Brooklyn. The north end of Queens will be served by extensions to existing rapid transit lines. The new system in Manhattan will consist of a trunk line running from the Bronx down Second Ave., terminating at Water and Pine Sts., with a connection through Worth St. to meet the municipal line now under construction at Church St. Two new tunnels at Houston St. and at Grand St. will carry the new lines across East River, merging in South Fourth St., Brooklyn.

Construction of the first step in the municipal system, consisting of 57 route-miles, is far advanced, with parts of the lines expected to be in operation in 1931. The proposed second step of the municipal system will connect with the first step at several points and in some places will be extensions of the first step. The city expects to recapture part of the Brooklyn-Manhattan Transit Company's Liberty Ave. line as part of the new system.

Chef Menteur Highway Bridge Near New Orleans Opened

The first of two bridges being built by the Louisiana State Highway Department across the passes at the lower end of Lake Pontchartrain to provide a toll-free outlet from New Orleans to the east was opened to traffic Sept. 11. The completed structure spans Chef Menteur, and consists of two through-steel trusses of 250 ft. and one 270-ft. swing span, with three-span concrete pile trestle approaches at each end. The second bridge, across Rigolets Pass, will be completed by the first of the year. The two bridges will be connected by a 10-mile concrete highway.

Construction of these bridges was commenced soon after the completion of a 5-mile private toll bridge across the lower end of Lake Pontchartrain. Operation by the state of free ferries adjacent to the new bridges forced the toll bridge company into the hands of receivers, as was noted in *Engineering News-Record*, Feb. 7, 1929, p. 247.

Sewer Blasts Wreck 50 Buildings at Newburgh, N. Y.

One person was killed, about 80 were injured and 50 buildings were damaged in a series of explosions which occurred Sept. 16 in the main business district of Newburgh, N. Y. Although no official statement has been made, it is believed that gases accumulating in the sewers as a result of an unusually high tide blocking the outfalls became ignited in some unexplained manner. Within a few moments of the explosion, several fires were blazing, but these were quickly extinguished by the fire department with the aid of apparatus from neighboring towns. An investigation is under way to determine whether an unusual amount of gasoline was present in the sewer, as has been reported.

On Aug. 24, 1928, a series of similar explosions in the same sewer resulted in property damage amounting to approximately $500,000, but no one was injured. The investigation undertaken at that time failed to locate any definite cause for the accident.

New Water Board Controls Waste Discharge in Illinois

Authorization of the discharge of liquid wastes into the streams of Illinois is under the control of a newly created Sanitary Water Board composed of the directors of the departments of Health, Agriculture, Conservation and Purchase and Construction together with a representation of the manufacturing interests of the state appointed by the Governor. The chief sanitary engineer of the Department of Health is technical secretary.

The duty of the board is to study, investigate and determine ways and means of eliminating stream pollution. No additions or changes to existing systems are to be made without a permit from the board. Plans for sewer systems satisfactory to the board must be submitted before permits will be issued. The board may require plans of existing systems and other information as to installation and operation. Power is given to establish standards of purity of streams. Penalties for non-compliance are $100 per day. The act exempts the territory of the Sanitary District of Chicago.

Two Maine Towns Accept, One Rejects, Manager Government

Besides Portland, which, as noted in these columns last week, rejected on Sept. 9 a proposed change from the manager form of government, two other civil units of Maine voted on the same question. Sanford, the largest town in the state, voted, 1,498 to 1,119, to retain its selectman government and the city of Belfast adopted by a vote of 650 to 283 a new charter providing for city manager government.

7,000,000 Cu.Yd. Fill Placed in Saluda Dam to Sept. 1

Over 7,000,000 of the required 11,000,000 cu.yd. of earth embankment had been placed in the Saluda dam, near Columbia, S. C., by the first of this month. What is probably a record in dirtwork was established during the month of July, when 701,000 cu.yd. of fill was placed. This was nearly equaled during August, when 684,000 cu.yd. was placed. The upstream trestle is now at El. 325, with two more lifts to go to reach the crest of the dam, El. 372, which is 208 ft. above streambed. Filling the reservoir commenced Aug. 31, when the sluice gates were closed. At present the water will not be allowed to rise higher than El. 290. The dam is being built by the semi-hydraulic method.

Washington Power Project Resubmitted to Voters

At a special election to be held Sept. 30, the voters of Centralia, Wash., will be asked to approve for the second time plans for a $1,000,000 municipal power project on the Nisqually River. The ordinance authorizing the special election was passed by the city council following the action of the Supreme Court of Washington, which on Aug. 24 issued an injunction restraining the city of Centralia from issuing public utility bonds in the amount of $650,000 and from proceeding with the construction of its power project. The injunction was granted on the ground that notice of election had not been published in the city's official newspaper the requisite number of times.

Government Must Deposit Money to Pay Floodway Damages

Until the U. S. government deposits $200,000 in court it cannot proceed with construction of the inland levee for the Missouri floodway in New Madrid and Mississippi counties along the Mississippi River. Judge Faris in federal court has ruled that landholders must have unquestioned assurance that any losses they may suffer will be paid.

U. S. Will Settle Claims of "Norman" Victims' Relatives

The U. S. government will pay approximately $200,000 damages to relatives of persons who lost their lives in the sinking of the steamer "Norman" in the Mississippi River in 1925. This decision, it is announced from Washington, is the result of a conference at which the Attorney-General and Solicitor-General decided that the government would not take an appeal to the decision handed down on the test suit of Mrs. Annette Shearer, whereby she was awarded damages of $7,500 for the death of her husband.

The U. S. steamer "Norman" capsized in Cow Island Bend, 16 miles below Memphis, on May 8, 1925. Aboard were 65 persons, passengers and crew, of whom 23 were drowned. The majority of those who lost their lives in the disaster were delegates to the convention of Engineers of the Mid-South, and the death list included some of the nation's most prominent engineers. Twenty-seven suits for damages were filed and by agreement Mrs. Shearer's was made a test case.

A description of the disaster by W. W. De Berard, associate editor of *Engineering News-Record*, who was one of the survivors, appeared in our issue of May 14, 1925, p. 827.

Applications Requested for Boulder Dam Power

The U. S. Department of the Interior has sent notices to all prospective purchasers of power to be generated at Boulder dam that their applications for such power must be filed with the department in Washington not later than Oct. 1. The parties concerned are principally municipalities in the lower Colorado basin, including the states of Arizona, California and Nevada. Applications must state the quantity of power desired and contain a general statement concerning the purposes and place of use of the power covered by the application.

Oklahoma's Highway Engineering Force to Be Reorganized

A. R. Losh, of Fort Worth, Tex., who has been federal district engineer, has been appointed state highway engineer of Oklahoma and has been authorized to reorganize the department's engineering force. The highway commission has declared that it expects such reorganization and that more attention will be paid to maintenance. Mr. Losh will receive $12,000 a year.

One Natural Gas Line Approved, Another Denied

In two decisions issued Sept. 3 the California Railroad Commission granted a certificate of public convenience and necessity to the Pacific Gas & Electric Company to construct and operate a 20-in. natural gas transmission line from Pinoche Pass, in Fresno County, to Richmond, in Contra Costa County, and denied the application of the Western Natural Gas Company for a certificate to construct a similar line from the Kettleman Hills and Dudley Ridge oil fields to Richmond, with branch lines to serve Modesto, Stockton, Lodi and Sacramento. The decision granting the certificate to the Pacific Gas & Electric Company was unanimous, but Commissioners Seavey and Carr dissented from that denying the other application.

BRIDGE OVER ST. LAWRENCE RIVER AT MONTREAL

Work on the Montreal-South Shore bridge over the St. Lawrence River, is now approaching completion. The suspension span of the main cantilever span was closed July 16. The cantilever section, a 1,097-ft. span with two 420-ft. anchor arms, is approached from the south by 24 Warren deck trusses varying from 90 to 240 ft. in length, and on the north by twelve similar spans. There is a 37½-ft. clear roadway with outside rapid-transit tracks and walkways, making a total width of 72 ft. 5 in. Designing and supervising engineers for the Montreal Harbour Commission are Monsarrat & Pratley, of Montreal. The Dominion Bridge Company, of Montreal, is fabricating and erecting the superstructure. The main span has a clearance of not less than 162 ft. over a 500-ft. section of the channel. Delay on the approaches in the city may hold up the opening of the bridge.

Brief News

AERIAL MAPPING AND SURVEYING will be offered as a course of study by the school of engineering of Syracuse University this fall. This is said to be the first course of the kind at any university in the country.

CONTROL OF PEDESTRIAN TRAFFIC on Market St., San Francisco, was inaugurated Sept. 11, when the city's new signal system was placed in operation. The system consists of 188 pedestrian traffic signals installed at every Market St. intersection between the Embarcadero and Van Ness Ave.

CIVIL SERVICE POSITIONS of an engineering nature to be filled in the near future include the following: assistant editor, to fill a vacancy in the U. S. Coast and Geodetic Survey, $2,600 a year; fire marshal, for the District of Columbia, $3,250 a year. Full information may be obtained from the U. S. Civil Service Commission, Washington, D. C., or at the post office or custom house in any major city.

AMERICAN COMPANIES MAY BID, if they are registered in Brazil, on materials to be used in the construction of a hospital to be built by the city of Nictheroy, Rio de Janiero. The hospital will have a capacity for 460 beds and facilities for 1,000 patients. It may be possible for American companies not registered in Brazil to bid through reputable Brazilian firms. Porto D'Ave is the engineer.

ENLARGEMENT OF THE DRY DOCK at Charleston, S. C., to accommodate the U. S. Navy's new 10,000-ton cruisers will be done by the McDougald Construction Company, of Atlanta, Ga., which bid $243,000. The work must be completed within 540 days after its commencement, which will be within the next two weeks.

HEARING OF THE SUIT of the Moffat Tunnel Commission against the Denver & Salt Lake Railroad Company, in which the commission sought to have declared invalid the lease made with the railroad company for the use of the Moffat tunnel, was completed on Aug. 31, and the matter is now in the hands of Judge J. Foster Symes, of the federal district court, for decision.

A HIGHWAY EXPANSION PROGRAM in Maine is assured by the adoption by referendum vote on Sept. 9 of a bill authorizing issuance of $15,000,000 bonds for construction and maintenance of highways and bridges to extend over a period of five years. A constitutional amendment for a $1,200,000 bond issue for a bridge over the Penobscot River near Bucksport was also passed.

FOREST FIRES in the United States during the latter part of August accounted for the expenditure of more than $1,000,000 during a three-weeks period by the Forest Service of the U. S. Department of Agriculture. During the past season more than 500,000 acres have been burned over in Western national forests, with a reported total of 5,025 separate blazes, of which 3,016 are blamed on lightning and 2,009 on human agencies. In Idaho alone approximately 5,000 men were engaged at one time in fighting fires.

CHILE will hold its first national congress of transit and motorized transportation in Santiago Nov. 10-20, 1929, according to information received by the U. S. Department of Commerce.

TO SUPPRESS FOREST FIRES in New York State an amendment to the Constitution will be voted on in November, giving the state authority to contract bills for that purpose. A ruling by the Attorney-General is construed as implying that such authority does not now exist.

WASHINGTON NOTES

BY PAUL WOOTON
Washington Correspondent

Chicago Diversion and River Levels—New Engineer Chief to Review New Orleans Bridge

FOR the purpose of improving navigation in the Mississippi River the Inland Waterways Corporation has requested that the diversion from Lake Michigan at Chicago be increased to 10,000 sec.-ft. daily during the remainder of September and the month of October. The Secretary of War is not expected to grant the request, on the ground that the additional diversion would not improve navigation conditions as far down as the Memphis area, where the difficulties are being experienced. Low water in the Mississippi has made it necessary for the Waterways Corporation to curtail its service on that stream. An embargo has been placed on grain and other bulk commodities. A part of the difficulties which the barges have been encountering was blamed upon experiments in Chicago in the reduction of the diversion. In that connection, it is admitted that the diversion was cut down for a few days to a varying extent, but in no case below 3,000 sec.-ft. Immediately following that reduction, however, 13,000 sec.-ft. was released daily until the regular daily average was restored. The Secretary of War is not convinced that this had any noticeable effect upon navigation in the Mississippi. Some question has been raised as to the authority of the Secretary to allow additional diversion at Chicago in view of the opinions expressed by the Supreme Court on the subject. The majority view, however, is that he has the authority to authorize additional diversion intended for navigation purposes. While no actual studies have been made on the exact effect of the diversion at Chicago on the Mississippi at Memphis, some attention was given a few years ago to the effect on the Mississippi of the Tennessee River. In that instance it was found that the release of all of the water impounded at Muscle Shoals would have a negligible effect on navigation depths in the Mississippi.

Railroad Consolidation Plan

Publication by the Interstate Commerce Commission of its "final" plan of railroad consolidation may be expected about Jan. 1, according to the statement of its chairman, Commissioner Ernest I. Lewis. Individual members of the commission have had before them during the summer the tentative plan prepared by Commissioner Claude R. Porter, and when they assemble in October an agreement will be sought that incorporates the ideas of a majority. As the various members of the commission hold divergent views on the grouping of the railroads, it will be many weeks before the plan emerges from their conferences in final form. Some hope is still entertained that Congress may revoke in the meantime the direction given to the commission by the transportation act of 1920 to prepare such a plan but, lacking such action, the commission is committed to completing the task, as its chairman announced before the House committee on interstate and foreign commerce last spring that it would do so.

Hudson Bay Railroad Refusing Commercial Traffic

The Hudson Bay Railroad's new line to Port Churchill is not expected to attract much traffic from the states in the Pacific Northwest. The new route to the Atlantic via Hudson Bay apparently will not offer any greater inducement to the farmers in the northern tier than that which the St. Lawrence route now presents. Grain along the northern edge of these states now is crossing the border to get the advantage of the lower rates over Canadian rails to Fort William, but this movement is so small that the Great Northern no longer is attempting to hold such business.

The principal source of traffic for the new line, originally projected to provide an outlet for Saskatchewan grain and other products of western Canada, promises to be coal and other minerals discovered in the area between The Pas and Port Churchill. In anticipation of the completion of the line, equipment and supplies for mining camps have been carried into the muskeg by airplane. Since the rails were laid over the snow into Churchill last spring there have been incessant pleas that the road accept commercial business. So far the traffic has been confined to the transportation of supplies needed at the terminal on Hudson Bay. Ballasting was completed this month, but the second and third lifts of track must be made before the line will be open to the public. After the golden spike is driven next year it will be two or three years before the harbor terminal facilities at Port Churchill

will be completed. Dock and elevator construction must wait upon completion of extensive dredging operations at the port to accommodate oceangoing vessels.

Water-Power Control Changes

The suggestion by the Secretary of War that a change be made in the water-power act so as to relieve himself and the Secretaries of the Interior and Agriculture from the responsibilities of administering the act does not raise a new question. When the bill was under consideration the point was made that the three Secretaries would not have time to give real consideration to the questions constantly coming before the commission. Since the approval of the act there have been periodic suggestions that the commission be otherwise constituted. In addition to the fact that members of the Cabinet already are overburdened with responsibilities, the point is made that three political leaders, as the heads of departments invariably are, hesitate to pass upon matters where political consequences are involved.

As the three departments particularly interested in power development have legitimate reasons for asking to have a hand in the administration of the law, it is suggested that the commission could be made up of the Chief of Engineers, the director of the Geological Survey and the chief forester. As the heads of technical bureaus these men, practically speaking, are in a position to be independent of political influences and are better qualified to pass upon the engineering and technical questions involved. Any plan to create an independent commission probably would meet with objection from the President and would be strongly opposed in Congress. Indications are, however, that some consideration will be given this matter at the December session.

To Reconsider New Orleans Bridge

After discussing the New Orleans bridge situation with the President and with the Secretary of War, a Louisiana delegation of state and city officials accepted a proposal of Secretary Good that a rehearing of the application be had before the new Chief of Engineers before referring the matter to a fact-finding commission. Secretary Good pointed out that under the law the Secretary of War alone may not authorize the construction of a bridge; the concurrence of the Chief of Engineers is mandatory. This means that the recommendation of the commission would have to be approved by the Chief of Engineers. Secretary Good suggested that before further consideration is given the commission plan, much time and effort might be saved were the matter first laid before the new Chief of Engineers.

The President is awaiting the nomination of two members by the Governor of California before naming the commission to report on the San Francisco bridge.

Personal Notes

Major EDWIN H. MARKS, Corps of Engineers, has been transferred from the office of the Chief of Engineers to the War Department General Staff.

Commander RALPH WARFIELD, U. S. Navy, has been appointed by President Moncada of Nicaragua to take charge of the road-constrtuction program in the vicinity of Ocotal. The program calls for a total expenditure of $150,000 at the rate of $25,000 monthly.

A. S. REA, chief engineer of the department of tests of the Ohio State Highway Department, has been appointed a member of the highway research board, a branch of the National Research Council, to make a study of aggregates.

Col. MAX TYLER, chief engineer of the Federal Power Commission, will be designated to serve as a member of the board of engineers for rivers and harbors. This service will be in addition to his regular duties with the Power Commission.

T. A. KELLY, bridge designer in the Colorado Highway Department, has accepted the office of assistant in the civil engineering department of the Colorado School of Mines, Golden. Mr. Kelly is a graduate of the University of Colorado with the degree of B.S. in civil engineering.

Dr. Ing. D. THOMA, professor of hydraulics, water-power machinery and water-power plants and director of the Hydraulic Institute at the Technische Hochschule, of Munich, Germany, will deliver a series of illustrated lectures on "Hydraulic Turbines and Related Subjects in Water-Power Plant Design" in the department of civil engineering, Massachusetts Institute of Technology, Oct. 2 to 28.

LEON S. MOISSEIFF, consulting engineer to the Port of New York Authority on the large bridges which it is building, sailed for Moscow on Sept. 18 at the invitation of the Soviet Commissariat of Ways and Communications to consult on its bridge problems. He expects to return to the United States in about two months.

GEORGE M. PURVER, consulting engineer, of New York, has recently returned from Russia, where he spent a few months gathering information regarding the proposed subway construction in Moscow, and studying in general conditions for building operations.

ERNEST SLATER, member of the Institution of Electrical Engineers and of the Institution of Mechanical Engineers and also editor of the British electrical weekly the *Electrical Times*, will visit the United States in October with a view to obtaining the latest information concerning electric power development in this country and in Canada.

Society Calendar

AMERICAN ASSOCIATION OF PORT AUTHORITIES, New Orleans; eighteenth annual convention, Quebec, Sept. 23-26.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington; annual meeting, San Antonio, Tex., Nov. 12-15.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; annual meeting, New Orleans, La., Feb. 11-13, 1930.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; annual convention, Minneapolis, Minn., Sept. 30-Oct. 4.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; fall meeting, Boston, Mass., Oct. 9-11.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; annual meeting, New Orleans, La., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis; annual convention, Philadelphia, Pa., Oct. 14-18.

ASPHALT PAVING CONFERENCE, New York City; annual meeting, West Baden, Ind., Oct. 28-Nov. 1.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington; annual meeting, Minneapolis, Minn., Sept. 28-30.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago; annual conference, Jacksonville, Fla., Oct. 14-16.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Washington; annual meeting, Chicago, Ill., Dec. 4-6.

NATIONAL SAFETY CONGRESS, Chicago; annual meeting, Chicago, Sept. 30-Oct. 4.

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.; annual convention, Tulsa, Okla., Oct. 14-16.

Obituary

WILLIAM W. DRINKER, chief engineer for the Port of New York Authority, died on Sept. 17. He was 60 years old. After an active career in railroad engineering work with the Lackawanna, the Delaware & Hudson and the Erie railroads, Mr. Drinker became terminal engineer of the New York-New Jersey Port and Harbor Development Commission upon its creation in 1918. When the work of that commission was taken over by the Port Authority, he remained with it in the same capacity, later becoming acting chief engineer. He had been chief engineer since 1923.

WILLIAM J. BOUCHER, construction engineer of the Port of New York Authority, died of a heart attack while swimming at Long Branch, N. J., on Sept. 14. He was 54 years old. Born in Jersey City, N. J., Mr. Boucher attended Stevens Institute of Technology, and after graduation in 1896 as a mechanical engineer, spent considerable time in mechanical engineering work before entering construction work with the Rapid Transit Subway Construction Company of New York in 1901. Since that time his work had been largely on design and construction of subways, railway and port facilities in and around New York and Philadelphia. He was first engaged by the Port Authority in 1923 as design engineer, becoming engineer of construction in 1926. Mr. Boucher was active in affairs of the American Society of Civil Engineers, having served as assistant treasurer for a number of years.

Construction Equipment and Materials

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of August, 1929, and also the total number of square yards awarded for roads, streets and alleys in the United States for the year 1929 to date as of Aug. 31:

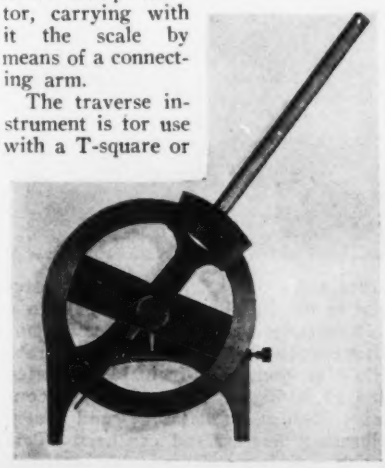
	Sq.Yd. Awarded During August, 1929	Sq.Yd. Awarded From Aug. 1, 1929 to Aug. 31, 1929
Roads	7,009,910	69,200,671
Streets	4,654,418	31,870,090
Alleys	303,560	2,401,639
Totals	11,967,888	103,472,400

New Developments

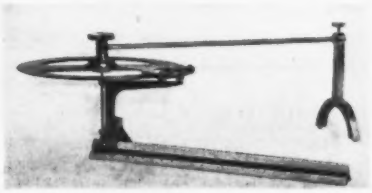
Office Survey Work Reduced by New Drafting Instruments

In an effort to simplify the platting of survey notes, two new instruments have been developed by the Miner & Leatherman Company, Coldwater, Mich. Use of these instruments, it is claimed, will reduce the time required for office work and at the same time result in greater accuracy and cleanliness. The topographic instrument is equipped with a standard 8-in. nickel silver protractor with vernier, similar to those used on transits, mounted on a vertical axis, at the base of which is a standard triangular scale. As the protractor is 5 in. above the drawing, there is ample room to work beneath it. The protractor and vertical axis do not rotate, therefore the small pinhole at the base of the instrument is not enlarged. The axis is maintained in the vertical position by a 13½-in. radius rod supported by a pedestal mounted on two rubber pads to protect the drawing and prevent slipping. In use, the vernier is rotated above the protractor, carrying with it the scale by means of a connecting arm.

The traverse instrument is tor use with a T-square or



TRAVERSE INSTRUMENT FOR USE WITH T SQUARE



IMPROVED TOPOGRAPHIC INSTRUMENT

straight-edge, and is equipped with the same type of protractor with rotating vernier connected with a traverse arm which has two parallel sides, so that the more convenient side may be used. The vertical axis is stationary, but the protractor may be rotated upon it by loosening the large nut at its upper terminus. The machine is quickly clamped by means of a thumb lever, and has a slow motion adjustment for fine setting. Both instruments are made of Monel metal.

Holder Grips Welding Electrode in Any Position

As a supplement to its line of electric arc-welding equipment, the General Electric Company, Schenectady, N. Y.,

CLAMP FOR ELECTRODE WIRE

announces a clamp-type electrode holder. This device has jaws of heavy copper alloy, notched to hold firmly in any position any size of electrode wire from ⅛ to ¼ in. in diameter. A molded compound handle protects the operator from heat and from contact with current-carrying parts. The holder is designed for use with currents up to 300 amp. It may be obtained, if desired, assembled with 5 ft. of flexible cable and terminal.

Pipe-Jointing Material Made in Solid Form

For use in joining bell-and-spigot cast-iron pipe a new joint compound in cake form has been developed by the Atlas Mineral Products Company, Mertztown, Pa., which is known as Mineralead. The main advantage claimed for this material is that it is impervious to moisture and can be stored in damp warehouses or even out of doors without injury. As no calking is required, it is unnecessary to dig deep bell holes, so that excavation costs are reduced. Mineralead melts at a temperature of 248 deg. F. and should be poured at approximately 270 to 280 deg. F. At 320 deg. the material begins to thicken, so that it cannot be poured above this temperature. A recent test of 6-in. cast-iron pipe joined with Mineralead showed that a deflection of 11½ in. could be successfully sustained by four lengths of pipe under a pressure of 300 lb. per sq.in.

Heavy-Duty Truck Drives Through Front and Rear Wheels

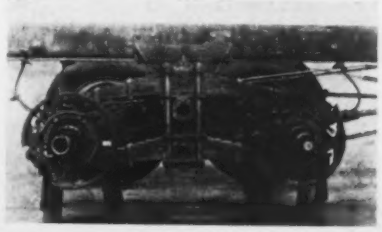
For unusually severe service over bad roads, the Four Wheel Drive Auto Company, Clintonville, Wis., has developed a six-wheel truck with power transmitted to the road through the front and first pair of rear wheels. This is, in effect, the well-known type of FWD truck with an added pair of load-carrying wheels at the rear. Motor and transmission are patterned after the older model, the main change being in the suspension of the two rear axles,

CHASSIS OF NEW SIX-WHEEL TRUCK

shown in the illustration. Two semi-elliptic springs are used on each side of the frame, each of which is 44 in. long. One of these is above a pivot, the other below. The pivot point is a steel cross-shaft which is rigidly secured to the frame by two heavy steel brackets. At the outer end of the springs the two axles are fastened by means of ball-and-socket joints, permitting a maximum of flexibility without distortion of the springs or frame of the truck. The driving force is transmitted through these springs, but torsion rods are provided to eliminate any tendency to twist in the first rear axle.

As the service or foot brake operates through the transmission, it is applied to the same wheels as the driving force. The emergency brake operates on the four rear wheels and is of the internal expanding type. Thus two independent sets of four-wheel brakes are provided.

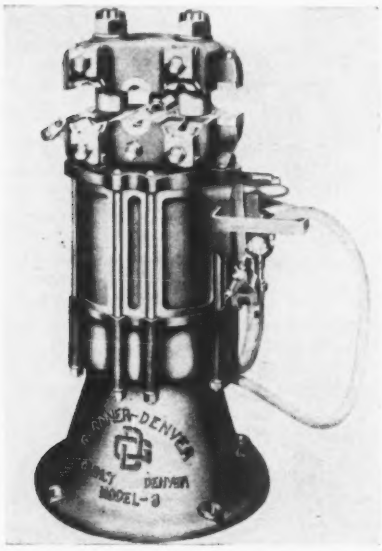
The truck has the usual FWD transmission with five forward and one reverse speeds. Axle clearance is 10½ in. It has a rated capacity of 6 tons, with a chassis weight of 9,500 lb. The six-cylinder motor develops 87 hp. at 2,500 revolutions per minute.



SPRING SUSPENSION OF REAR AXLES

New Drill Sharpener Announced

For use in the contracting and general construction field, the Gardner-Denver Company, Denver, Colo., has developed a model DS-3A double-cylinder small drill-steel sharpener 44½ in. high with a base diameter of 24 in., and



SHARPENER FOR LIGHT STEEL

a weight of 1,500 lb. The machine is equipped with two vertical cylinders, the upper being used independently in forging operations and the lower cylinder brought into play only when clamping. It will forge bits and shanks and sharpen section drill steel not exceeding 1¼ in. in diameter and not requiring a bit of more than 2½ in., form lug shanks on 1-, 1⅛- and 1¼-in. round steel and make collared shanks of 3¼ and 4¼ in. on ⅞- and 1-in. hexagon or quarter-octagon steel.

New Publications

Excavating Machinery—MANITOWOC ENGINEERING WORKS, Manitowoc, Wis., in a 32-p. illustrated catalog gives detailed specifications and working dimensions of Moore speedcranes, shovels, draglines and trench hoes. A number of job photographs are given showing the machine in actual operation.

Locomotives—GEORGE D. WHITCOMB COMPANY, Rochelle, Ill., has prepared a 10-p. booklet, "Locomotives With Internal Combustion Engine Drive," telling of the advantages, uses and economy effected by using locomotives of this type.

Hydraulic Dredges—AMERICAN STEEL DREDGE COMPANY, Fort Wayne, Ind., has issued a folder on hydraulic dredges, which it is now prepared to furnish in sizes from 6 to 16 in. inclusive.

Lumber—APPALACHIAN HARDWOOD CLUB, Cincinnati, Ohio, is distributing a 4-p. brochure, "Protection Through Selection," discussing hardwood lumber specifications.

Street Resurfacing—THE TEXAS COMPANY, New York City, describes in a 7-p. illustrated booklet methods of resurfacing worn brick and block pavements with Texaco asphalt.

Chains and Conveyors—CHAIN BELT COMPANY, Milwaukee, Wis., has published a catalog and engineering data book of 516 pages containing detailed descriptions of the products of the company and its subsidiary, the Stearns Conveyor Company, and engineering data for the selection of chains and chain drives, elevators and conveyors, traveling water screens and construction machinery. Special sections deal with the application of this equipment in the mechanical handling of material in specific industries, including power plants, cement mills, pulp mills, sewage-disposal plants and many others. The last 30 pages of the catalog contain engineering data.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Sept. 1,	**1929**	**207.57**	**August,**	**1929**	**290**
Aug. 1,	1929	205.91	July,	1929	320
Sept. 1,	1928	207.29	August,	1928	306
Average,	1928	206.78	Average,	1928	287
Average,	1927	206.24	Average,	1927	263
1913.....		100.00	1913.....		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Sept. 19, with some comparisons, total as follows:

(In Thousands of Dollars)

	Sept. 19, 1929	Sept. 12, 1929	Sept. 20, 1928
Building:			
Industrial.....	$5,517	$6,678	$7,397
Commercial.....	50,105	29,863	43,713
Streets and roads.	12,388	12,603	17,476
Other eng. constr.	7,062	12,062	23,951
Total.....	$75'072	$61'206	$92,536
Total, all classes, Jan. 1 to Sept. 19:			
1929.....			$3,113,263
1928.....			2,616,877

Business Notes

HUNTER MACHINERY COMPANY, Milwaukee, Wis., has appointed H. O. Stamp general sales manager of the Wisconsin and Michigan companies.

GARDNER-DENVER COMPANY, Denver, Colo., has let contracts for a new building addition at its Quincy, Ill., plant which will give a 50 per cent increase in production.

LINK-BELT COMPANY, Chicago, Ill., announces the resignation of F. B. Caldwell, vice-president in charge of the Chicago plant. He will be succeeded by W. C. Carter, formerly vice-president in general charge of production at all Link-Belt plants. E. J. Burnell has been appointed sales manager of the Western division, with headquarters at Chicago, and Nels Davis manager of the Pittsburgh office.

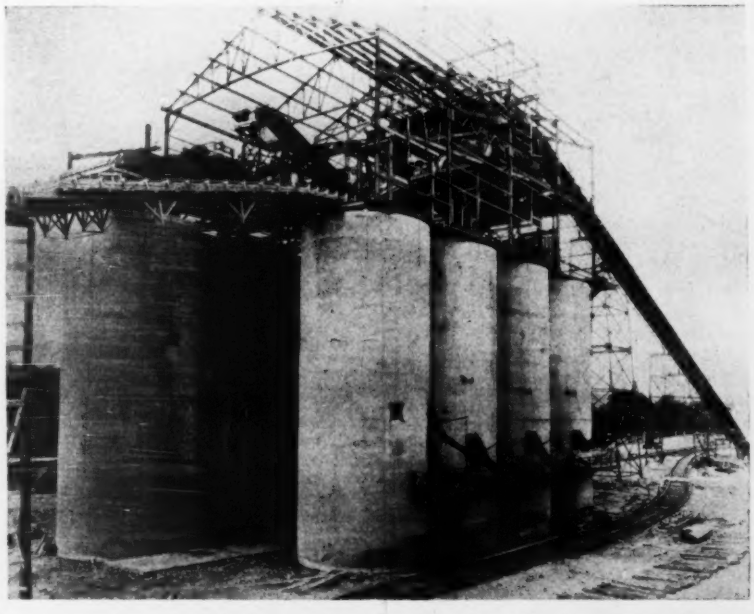
MORRISON RAILWAY SUPPLY CORPORATION, Buffalo, N. Y., has appointed George J. Diver, formerly president of the Interstate Car & Foundry Company, of Indianapolis, general manager of sales in charge of its frog and switch division. His headquarters will be in Chicago. The company is planning to begin operations at its new Chicago plant about Sept. 15.

E. I. DU PONT DE NEMOURS & CO., Wilmington, Del., has appointed John W. McCoy general manager of its explosives department. He succeeds J. Thompson Brown, who has been elected a member of the executive committee of the company. Edward B. Yancey, formerly manager of the Birmingham plant, succeeds Mr. McCoy as assistant general manager of the explosives department.

NYE ODORLESS INCINERATOR CORPORATION is moving its executive offices to Albany, Ga., where it has recently completed a new office building.

RAY P. MCGRATH, for fifteen years manager of the San Francisco office of the Sullivan Machinery Company, and previously connected with its Boston office, died Aug. 25. Mr. McGrath had been associated with the Sullivan company since 1902.

MODERN SAND AND GRAVEL PLANT IN OHIO



With a capacity of 3,000 tons per ten-hour day, the plant of the Van Camp Sand & Gravel Company, Cincinnati, Ohio, recently put into operation, is one of the largest and most modern in the country. The pit consists of nearly 200 acres of good sand and gravel, which is loaded by steam shovels into 20-cu.yd. standard-gage pneumatic dump cars. These discharge into a large receiving hopper of concrete and steel. From here the material is handled by conveyor belt to a 3-in. grizzly, thence to the main plant situated on the top of nine concrete silo bins, each of 20-ft. inside diameter and 50 ft. high. The main plant contains screens, sand tanks, sand drags, vibrating screens and crushers. Telsmith crushing and screening material is used throughout, the units being driven by General Electric motors.